

Orderer:

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Test Report No. C782QPEN

Tests according to EN 12975-2: 2001, Section 5

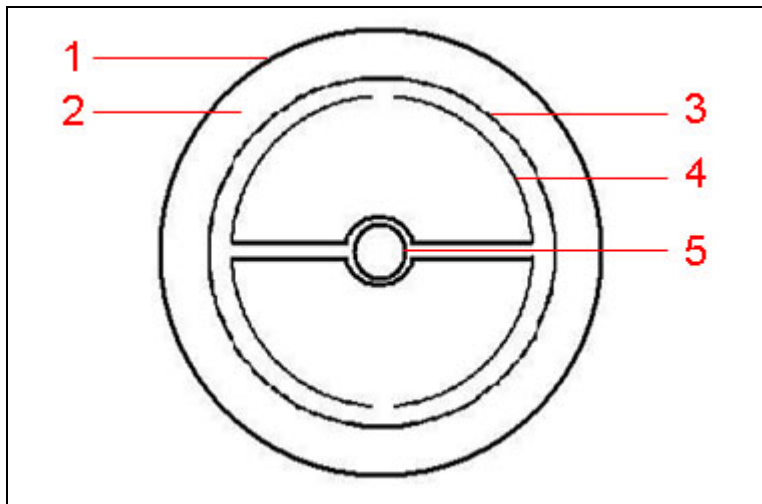
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1 Description of Collector

1.1 Technical data of sample

Product information		Absorber	
Manufacturer	Navitron Ltd	Absorber element	Evacuated double glass tube
Model	SFB 20	Length of absorber element	1639 mm
Type	Evacuated tube collector	Width of absorber element	37 mm
Flow	Heat Pipe	Thickness of absorber element	1.5 mm
Serial product	Yes	Coating	Graded Al-N/Al on glass
Drawing number	--	Flowed through element	Coppertube/Heatpipe
Serial number	--	Joining technique	--
Date of manufacture	01.11.2005	Seam	--
Physical parameters		Installation	
Gross length	1.639 m	On tilted roof	Yes
Gross width	1.466 m	In tilted roof	No
Gross height	0.134 m	On flat roof	No
Gross area	2.403 m ²	On flat roof with stand	Yes
Aperture area	1.747 m ²	Facade	Yes
Absorber area	2.655 m ²	Casing and insulation	
Weight (empty, incl. cover)	49.0 kg	Casing material	Stainless steel
Fluid capacity	1.1 Litre	Sealing material	EPDM
Construction		Insulation material	Rockwool compression-molded
Type	Evacuated tube collector	Thickness (in mm)	60
Number of absorber elements	20	Aperture dimensions	20 * (1.428 m * 0.044 m) + 19 * (0.995 m * 0.026 m)
Absorber pitch	70 mm	Limitations (manufacturer information)	
Number of hydraulically parallel tubes	1	Max. temperature	99°C
Number of thermally serial glazings	Single-glazed	Max. pressure	8 bar
Material of glazing(s)	Borosilicate glass	Other	--
Thickness of glazing(s)	1.6 mm	Test schedule	
Heat transfer fluid (manufacturer recommendation)		Test procedure	EN 12975, Outdoor
Type	Water	Sample received	30.03.2006
Specifications	--	Start of test	28.06.2006
Remarks on collector design		End of test	16.08.2006
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1.2 Sketch of collector



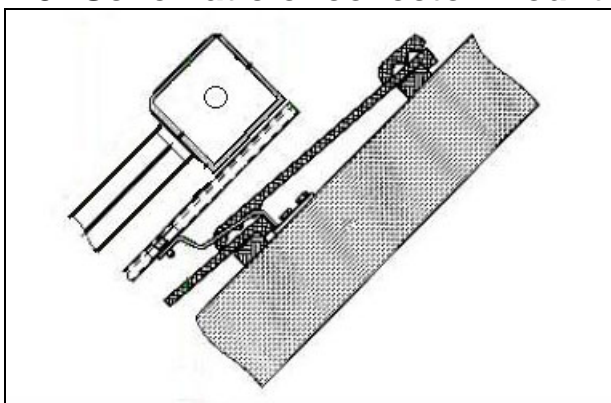
1.3 Specifications on elements

1	Glazing Material: Thickness [mm]:	Borosilicate glass 1.6
2	Vacuum	
3	Absorber Absorber element: Flow-through element: Length of element [mm]: Width of element [mm]: Flow type:	Evacuated double glass tube Coppertube/Heatpipe 1639 37.3 serial
3	Absorber coating Description:	Graded Al-N/Al on glass
4	Heat-conducting metal sheet Description:	Aluminum
5	Heat pipe Description:	Copper

1.4 Photo of collector



1.5 Schematic of collector mounting



2 Test methods and results

2.1 Tests of Durability

Tests carried out according to EN 12975-2: 2001.

*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	03.04.2006	5.2	Passed
High-temperature resistance	22.07.2006	5.3	Passed
Exposure	28.06.2006 – 29.07.2006	5.4	Passed
External thermal shock	Shock No.1	21.07.2006	Passed
	Shock No.2	21.07.2006	Passed
Internal thermal Shock	Shock Nr.1	18.07.2006	Passed
	Shock Nr.2	19.07.2006	Passed
Rain penetration	15.08.2006	5.7	Passed
Freeze resistance	--	5.8	N/A
Thermal performance	03.04.2006 - 11.06.2006	6.1 - 6.2 - 6.3	Passed
Impact resistance	--	5.10	N/A
Mechanical Load	--	5.9	N/A
Final inspection	15.08.2006	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 pressure (manufacturer information)	8 bar

2.3.3 Test conditions

Surrounding temperature	20°C
Test pressure	10 bar
Duration	15 min

2.3.4 Test results

Observations	None
Major failures	None

2.4 High-Temperature Resistance Test

2.4.1 Remarks on test procedure

Outdoor

Temperature sensor attached to the header tube. Direct measurement of the absorber temperature is not possible.

2.4.2 Test conditions

Collector tilt angle (degrees from horizontal)	27.2°
Average irradiance during test	1013 W/m ²
Minimum irradiance during test	1007 W/m ²
Average surrounding air speed	1.1 m/s
Average surrounding temperature	30.3°C
Minimum surrounding temperature	29.3°C
Average absorber temperature	228.2°C
Duration of test	>60 min

2.4.3 Test results

Observations	None
Major failures	None

2.4.4 Determination of stagnation temperature

Temperature sensor attached to the manifold tube

Stagnation temperature for 30°C/1000 W/m ²	225°C
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2.5 Exposure test

2.5.1 Remarks on test procedure

Outdoor exposure test. Collector installed on a tracker.

2.5.2 Test conditions

Part A (2.6.2.1)	Exposition for at least 30 days with a minimum daily irradiation $H \geq 14 \text{ MJ/m}^2$.
Part B (2.6.2.2)	Exposition for at least 30 hours at irradiance $G \geq 850 \text{ W/m}^2$ and ambient temperature $T_{\text{amb}} \geq 10^\circ\text{C}$. Minimum duration of every high-irradiance 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
28.06.2006	14.5	20.0	4.0	1
29.06.2006	11.2	20.0	7.3	1
30.06.2006	14.0	22.7	0.0	2
01.07.2006	14.0	22.7	0.0	3
02.07.2006	14.0	22.1	0.0	4
03.07.2006	14.0	23.6	0.0	5
04.07.2006	14.0	25.6	0.0	6
05.07.2006	14.0	15.7	18.2	7
06.07.2006	15.4	20.4	12.1	8
07.07.2006	7.0	18.1	10.2	8
08.07.2006	16.3	20.8	0.0	9
09.07.2006	21.8	23.1	0.0	10
10.07.2006	14.0	24.4	0.0	11
11.07.2006	16.5	26.6	0.0	12
12.07.2006	25.1	26.2	1.0	13
13.07.2006	26.1	25.0	1.5	14
14.07.2006	26.4	25.0	0.0	15
15.07.2006	24.3	24.7	0.0	16
16.07.2006	29.5	24.6	0.0	17
17.07.2006	29.4	24.5	0.0	18
18.07.2006	30.0	25.7	0.0	19
19.07.2006	32.6	27.0	0.0	20
20.07.2006	30.2	28.0	0.0	21
21.07.2006	31.1	28.1	0.0	22
22.07.2006	23.7	25.6	1.0	23
23.07.2006	26.9	26.4	0.0	24
24.07.2006	14.0	10.0	0.0	25
25.07.2006	14.0	10.0	0.0	26
26.07.2006	14.0	10.0	0.0	27
27.07.2006	14.0	10.0	0.0	28
28.07.2006	14.0	10.0	5.7	29
29.07.2006	20.2	22.4	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]
28.06.2006 15:05:00-15:53:00	959.0	27.0	48.0	48.0
29.06.2006 13:28:00-13:59:30	1155.5	23.8	31.5	79.5
30.06.2006 08:55:00-12:38:00	1012.5	24.4	223.0	302.5
01.07.2006 08:54:30-12:33:00	1016.2	24.9	218.5	521.0
01.07.2006 15:29:30-16:03:30	953.0	28.7	34.0	555.0
02.07.2006 12:02:30-16:04:30	990.1	28.2	242.0	797.0
03.07.2006 08:54:30-09:25:00	919.2	22.6	30.5	827.5
03.07.2006 12:31:00-13:39:30	1017.8	28.7	68.5	896.0
03.07.2006 13:48:00-15:57:00	944.9	30.8	129.0	1025.0
04.07.2006 08:54:30-09:45:00	904.5	25.6	50.5	1075.5
04.07.2006 12:54:30-16:05:30	973.6	33.1	191.0	1266.5
05.07.2006 09:33:00-10:42:30	984.3	26.5	69.5	1336.0
05.07.2006 11:02:30-11:57:30	1013.0	28.4	55.0	1391.0
05.07.2006 14:26:30-15:26:30	950.6	32.3	60.0	1451.0
09.07.2006 13:36:00-14:19:30	1036.8	28.8	43.5	1494.5
10.07.2006 11:26:00-15:10:30	1025.8	29.7	224.5	1719.0
11.07.2006 08:52:00-10:07:00	958.3	25.5	75.0	1794.0
11.07.2006 10:32:30-12:05:30	903.5	28.6	93.0	1887.0

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 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	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	None	

2.6 External Thermal Shock

2.6.1 Remarks on test procedure

Shock-No.1: Outdoor
Temperature sensor attached to the header tube.
Direct measurement of the absorber temperature is not possible.

Shock-No.2: Outdoor
Temperature sensor attached to the header tube.
Direct measurement of the absorber temperature is not possible.

2.6.2 Test conditions

Shock-No.		1	2
Conditioning phase			
Collector tilt angle	°	28.0	30.7
Average irradiance	W/m ²	995	981
Minimum irradiance	W/m ²	982	969
Average surrounding temperature	°C	31.3	33.7
Minimum surrounding temperature	°C	29.3	33.2
Period during which the required conditions were maintained before the shock	min	> 60	> 60
Shock			
Spray rate per m ²	l/(s·m ²)	0.03 – 0.05	0.03 – 0.05
Water temperature	°C	ca. 15	ca. 15
Duration of water spray	min	15	15
Absorber temperature prior to water spray	°C	224.2	221.9
Test combined with „Exposure Test“			
		Yes	Yes
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	Shock Nr.1	None
	Shock Nr.2	None

2.7 Internal thermal Shock

2.7.1 Remarks on test procedure

Shock-No.1: Outdoor
Temperature sensor attached to the header tube. Direct measurement of the absorber temperature is not possible.

Shock-No.2: Outdoor
Temperature sensor attached to the header tube. Direct measurement of the absorber temperature is not possible.

2.7.2 Test conditions

Shock-No.		1	2
Conditioning phase			
Collector tilt angle	°	26.2	31.7
Average irradiance	W/m ²	1035	1017
Minimum irradiance	W/m ²	1031	1007
Average surrounding temperature	°C	28.6	33.0
Minimum surrounding temperature	°C	27.5	31.9
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	ca. 15	ca. 15
Duration of water flow	Min	5	5
Absorber temperature prior to the shock	°C	226.0	229.0
Test combined with „Exposure Test“			
		Yes	Yes
Test combined with „High-Temperature Resistance Test“			
		No	No

2.7.3 Test results

Observations	Shock No.1	None
	Shock No.2	None
Major failures	Shock No.1	None
	Shock No.2	None

2.8 Rain penetration test

2.8.1 Remarks on test procedure

Outdoor test.

Collector installed on an open frame. Spraying from all sides.

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 of water spray	4 hours

2.8.3 Determination of water penetration

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

a) Visual inspection

2.8.4 Test results

Observations	None
Major failures	None

2.9 Final inspection

2.9.1.1 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	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

3 Remarks

This report may not be copied except in full.

This test report refers only to the item(s) tested.

This test report is issued according to the requirements of ISO 17025.

Rapperswil, 08.12.2006



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Test engineer