SPF Solartechnik Prüfung Forschung

Institut für Solartechnik
Hochschule für Technik Rapperswil
Oberseestrasse 10, CH 8640 Rapperswil
Tel +41 55 222 48 21, Fax +41 55 222 48 44
www.solarenergy.ch

STS 301

Ordered by:

Thermics S.r.l.
Via dell'Olmo 47

IT-33030 Varmo

Tel. +39 0432 823600
Fax: +39 0432 825847

Test Report No. C1319IMP

Hail Resistance Test for Solar Thermal Collectors

Test according to several standards

Content: **page**

1 Description of Collector

1.1 Technical Data of Sample

Product information	
Manufacturer	Thermics S.r.l.
Model	10 DTH-CPC
Type	Evacuated tube collector
Flow	Direct flow
Serial product	Yes
Drawing number	A complete set of technical drawings is filed at the test institute
Serial number	11001800016
Date of manufacture	21.01.2011

Physical parameters	
Gross length	1.965 m
Gross width	1.132 m
Gross height	0.140 m
Gross area	2.224 m²
Aperture area	1.962 m²
Absorber area	2.559 m²
Weight empty	49.0 kg
Fluid capacity	2.4 l

Construction	
Type	Evacuated tube collector
Number of absorber elements	10
Absorber pitch	110.0 mm
Number of hydraulically parallel tubes	10
Number of thermally serial glazings	1
Material of glazing(s)	Borosilicate glass
Thickness of glazing(s)	2.2 mm

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

Flow (manufacturers' recommendation)	
Flow range	60 - 180 l/h
Rated flow	120 l/h

Absorber	
Absorber element	Evacuated double glass tube
Length of absorber element	1741.0 mm
Width of absorber element	47.0 mm
Thickness of absorber element	1.50 mm
Coating	Cr-Al-N/Cu
Flowed through element	Coaxial copper pipe
Joining technique	--
Joining seam	--

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

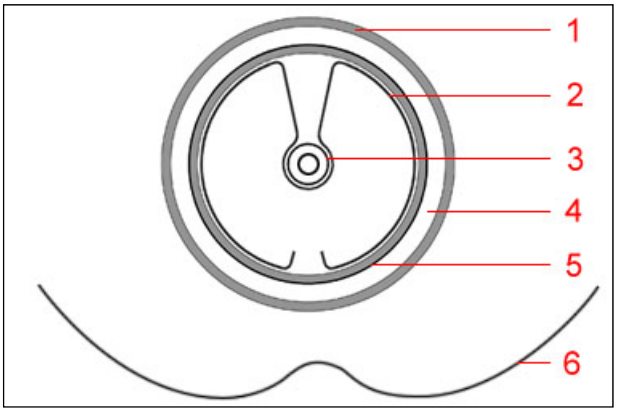
Casing and insulation	
Casing material	Aluminium
Sealing material	Silicone
Insulation material	Rockwool compression-moulded
Thickness (in mm)	30
Aperture dimensions	1.733 m * 1.132 m

Limitations (manufacturers' information)	
Max. temperature	Not specified
Max. pressure	6 bar
Other	--

Remarks on collector design
--

Test schedule	
Test procedure	EN12975:2006, Outdoor test
Sample received	08.02.2011
Start of test	08.02.2011
End of test	23.06.2011

1.2 Sketch of Collector



1.3 Specifications on Elements

1 Glazing

Material:	Borosilicate glass
Thickness [mm]:	2.2

2 Heat-conducting metal sheet

Description:	Aluminum

3 Coaxial tube

Description:	Copper

4 Vacuum

5 Absorber

Absorber element:	Evacuated double glass tube
Flow-through element:	Coaxial copper pipe
Length of element [mm]:	1741
Width of element [mm]:	47
Flow type:	Parallel

5 Absorber coating

Description:	Cr-Al-N/Cu

6 CPC reflector

Description:	Aluminum

1.5 Test Sequence and Summary

Test according to several norms (details below)

Test	Date(s)	Result
Hail resistance	17.06.2011 - 22.06.2011	See results in the respective chapters

1.6 Sampling

The collector was sampled according to the regulations of the Solar Keymark.

1.7 Test Conditions

Test using ice balls (laboratory ice, no visible cracks). The collector is installed vertically, horizontal impacts.
The collector is at room temperature. Identification of the impact points as described in Annex A.
Physical properties of the ice balls:

						Tolerance
Diameter [mm]	25	30	35	40	45	± 5%
Weight [g]	7.53	13.0	20.7	30.8	43.9	± 5%
Impact speed [m/s]	23.0	25.2	27.2	29.0	30.7	± 5%
Impact energy [J]	2.0	4.1	7.7	13.0	20.7	

Temperature for all ice balls -4°C ± 2°C or -20°C ± 2°C

1.8 Test Sequence

1.8.1 Remarks

None

1.8.2 Record of the impacts

Nr	Target	Ø [mm]	v [m/s]	G [g]	T [°C]	Result	Relevance
1	2T	25	21.90	7.50	-4	[OK]	EN/SPF
2	2T	25	22.70	7.74	-4	[OK]	EN/SPF
3	2T	25	21.90	7.36	-4	[OK]	EN/SPF
4	2T	25	22.20	7.31	-4	[OK]	EN/SPF
5	2T	25	22.60	7.48	-20	[OK]	SPF
6	2T	25	23.80	7.47	-20	[OK]	SPF
7	2T	25	23.60	7.52	-20	[OK]	SPF
8	2T	25	22.80	7.70	-20	[OK]	SPF
9	6T	25	23.80	7.86	-4	[OK]	EN/SPF
10	6T	25	23.30	7.69	-4	[OK]	EN/SPF
11	6T	25	23.70	7.76	-4	[OK]	EN/SPF
12	6T	25	24.20	7.73	-4	[+]	EN/SPF
13	6T	25	23.00	7.33	-20	[OK]	SPF
14	6T	25	22.60	7.26	-20	[OK]	SPF
15	6T	25	22.80	7.63	-20	[OK]	SPF
16	6T	25	22.90	7.50	-20	[OK]	SPF
17	8B	25	22.80	7.47	-4	[OK]	EN/SPF
18	8B	25	23.30	7.68	-4	[OK]	EN/SPF
19	8B	25	23.50	7.86	-4	[OK]	EN/SPF
20	8B	25	23.90	7.57	-4	[OK]	EN/SPF
21	8B	25	24.00	7.87	-20	[OK]	SPF
22	8B	25	23.10	7.68	-20	[OK]	SPF
23	8B	25	24.10	7.74	-20	[OK]	SPF
24	8B	25	23.40	7.78	-20	[OK]	SPF
25	9B	25	23.40	7.86	-4	[OK]	EN/SPF
26	9B	25	23.30	7.62	-4	[OK]	EN/SPF
27	9B	25	23.70	7.70	-4	[OK]	EN/SPF

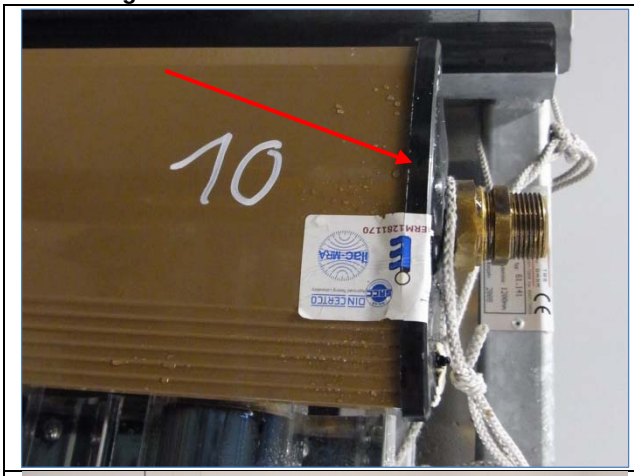
Nr	Target	Ø [mm]	v [m/s]	G [g]	T [°C]	Result	Relevance
28	9B	25	22.30	7.64	-4	[OK]	EN/SPF
29	9B	25	23.10	7.55	-20	[OK]	SPF
30	9B	25	23.50	7.67	-20	[OK]	SPF
31	9B	25	23.20	7.70	-20	[OK]	SPF
32	9B	25	23.60	7.68	-20	[OK]	SPF
33	3T	40	26.10	31.48	-20	[-]	SPF
34	3T	40	25.20	29.81	-20	[-]	SPF
35	3T	40	30.60	31.87	-20	[+]	SPF
36	3T	40	30.30	31.60	-20	[OK]	SPF
37	3T	40	28.10	29.75	-20	[OK]	SPF
38	3T	40	26.40	29.29	-20	[-]	SPF
39	3T	40	31.00	32.33	-20	[+]	SPF
40	5T	40	30.50	31.21	-20	[+]	a)
41	7T	40	27.70	31.10	-20	[OK]	SPF
42	7T	40	30.60	31.81	-20	[+]	SPF
43	7T	40	26.30	29.42	-20	[-]	SPF
44	7T	40	30.60	30.35	-20	[+]	SPF
45	7T	40	28.30	31.17	-20	[OK]	SPF
46	6B	40	30.20	31.92	-20	[OK]	SPF
47	6B	40	24.30	30.20	-20	[-]	SPF
48	6B	40	30.00	32.08	-20	[OK]	SPF
49	6B	40	29.40	32.10	-20	[OK]	SPF
50	6B	40	29.20	30.76	-20	[OK]	SPF
51	7B	40	27.70	32.27	-20	[OK]	SPF
52	7B	40	29.70	31.56	-20	[OK]	b)
53	4B	40	29.90	31.66	-20	[OK]	SPF
54	4B	40	29.50	32.08	-20	[OK]	SPF
55	4B	40	26.20	31.58	-20	[-]	SPF
56	4B	40	30.20	32.25	-20	[OK]	SPF
57	4B	40	27.30	32.27	-20	[-]	SPF
58	4B	40	30.00	32.31	-20	[OK]	SPF
59	3B	40	30.10	32.26	-20	[OK]	SPF
60	3B	40	28.30	31.90	-20	[OK]	SPF
61	3B	40	28.20	32.31	-20	[OK]	SPF
62	3B	40	27.30	31.88	-20	[-]	SPF
63	3B	40	29.40	32.10	-20	[OK]	SPF
64	4T	45	33.80	44.29	-20	[+]	a)
65	2T	45	34.70	44.52	-20	[+]	SPF
66	2T	45	33.20	45.61	-20	[+]	SPF
67	2T	45	32.70	46.07	-20	[+]	SPF
68	2T	45	31.20	45.09	-20	[OK]	SPF
69	6T	45	29.20	44.16	-20	[-]	SPF
70	6T	45	30.20	46.04	-20	[OK]	SPF
71	6T	45	29.10	45.52	-20	[-]	SPF
72	6T	45	31.60	44.87	-20	[OK]	SPF
73	6T	45	32.70	45.23	-20	[+]	SPF
74	6T	45	32.60	45.24	-20	[+]	SPF
75	2B	45	35.40	44.31	-20	[+]	X
76	3B	45	28.40	44.19	-20	[-]	X
77	X1	40	16.50	31.75	-20	[-]	SPF
78	X1	40	24.10	29.38	-20	[-]	SPF
79	X1	40	18.80	29.54	-20	[-]	SPF
80	X1	40	30.60	31.83	-20	[+]	SPF
81	X1	40	30.10	31.10	-20	[OK]	SPF
82	X1	40	26.40	31.73	-20	[-]	SPF
83	X1	40	29.90	31.22	-20	[OK]	SPF
84	X1	40	26.90	31.44	-20	[-]	SPF
85	X1	40	28.10	31.59	-20	[OK]	SPF
86	X2-1	40	26.50	31.59	-20	[-]	c)

Nr	Target	Ø [mm]	v [m/s]	G [g]	T [°C]	Result	Relevance
87	X2-2	40	28.20	32.26	-20	[OK]	c)
88	X2-3	30	25.00	13.33	-20	[OK]	c)

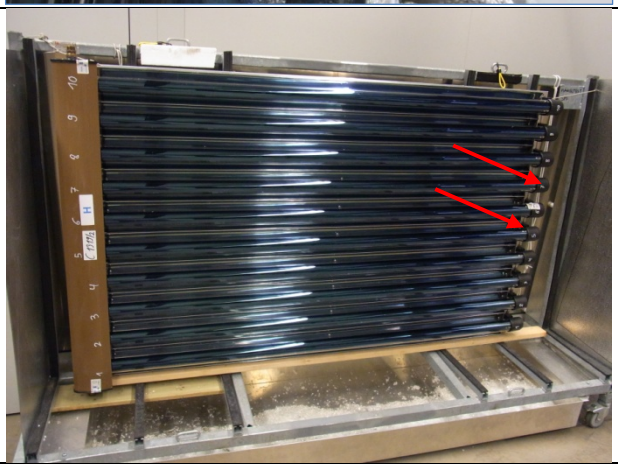
a) Tube breakage, velocity of ice ball is too high and therefore the shot is not considered valid
b) Tube breakage, According to the Paragraph 19.8 c) of the "VKF Prüfbestimmung Nr. 19 Therm. Sonnenkollektoren / 1.01" this tube is replaced by 2 additional tubes 3B and 4B (shots 53-63)
c) Severe damage of the targets

Nr Counting of the impacts
Target Corner according to Annex A, Extra targets are designated with X1, X2 and are described below
V Measured impact speed.
G Measured weight of the ice ball
T Temperature of the ice ball
Result
[OK] = Speed of the ball is within the tolerance, [X] = Not a valid shot.
[+] = Speed is too high, [-] = Speed is too low
Relevance
EN = Required for test according to EN12975-2:2006 Chapter 5.10.2.3 Method 2
SPF = Required for the test according to the SPF Test.

Extra Targets



Impact Position X1
Front side of the plastic side covers of the collector manifold.



Impact Position X2
Plastic parts at the bottom of the collector used to fix the tubes.

2 Test according to the EN12975-2:2006, Chapter 5.10.2.3, Method 2

2.1 Test Conditions and Test Sequence

Test with ice stones according to the EN12975-2:2006 Chapter 5.10.2.3 Method 2.
More information about the test procedure and about the properties of the hail stones in Chapter 2
For this test the according to the EN12975-2:2006 Chapter 5.10.2.3 Method 2 the impacts number 1-4, 9-12, 17-20, 25-28 are considered as relevant.

2.2 Results

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

Test	Test date	Chapter of norm	Result
Impact resistance EN12975-2:2006	17.06.2011	5.10	**Passed**

3 Test according to the SPF Standard

3.1 Test Conditions and Test Sequence

Test according to genuine SPF guidelines.

Test using ice balls in the style of the EN12975-2:2006 Chapter 5.10.2.3 Method 2.
More information about the test procedure and about the properties of the hail stones in Chapter 2

For this test the according to the SPF guidelines all impacts are considered relevant.

3.2 Test Results

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

Test	**Test date**
Hail resistance according to the SPF standard	15.06.2011
The evacuated tubes are considered hail proof for hailstones of at least **40 mm** diameter**.** The plastic parts of the collector are destroyed at **30 mm** hailstones.	

4 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. The test report fulfils the requirements of ISO17025.

This test report is issued electronically (.pdf document). To assure the integrity and genuineness of the test report, a verified original copy can be ordered anytime and free of charge (www.solarenergy.ch/i-Report). The required information is

Name: iC1319IMPe.pdf
Password: k9Z6f3CG

The original copy is delivered automatically to the indicated email address.

Authorised paper copies or translations can be ordered under the same address www.solarenergy.ch/i-Report.

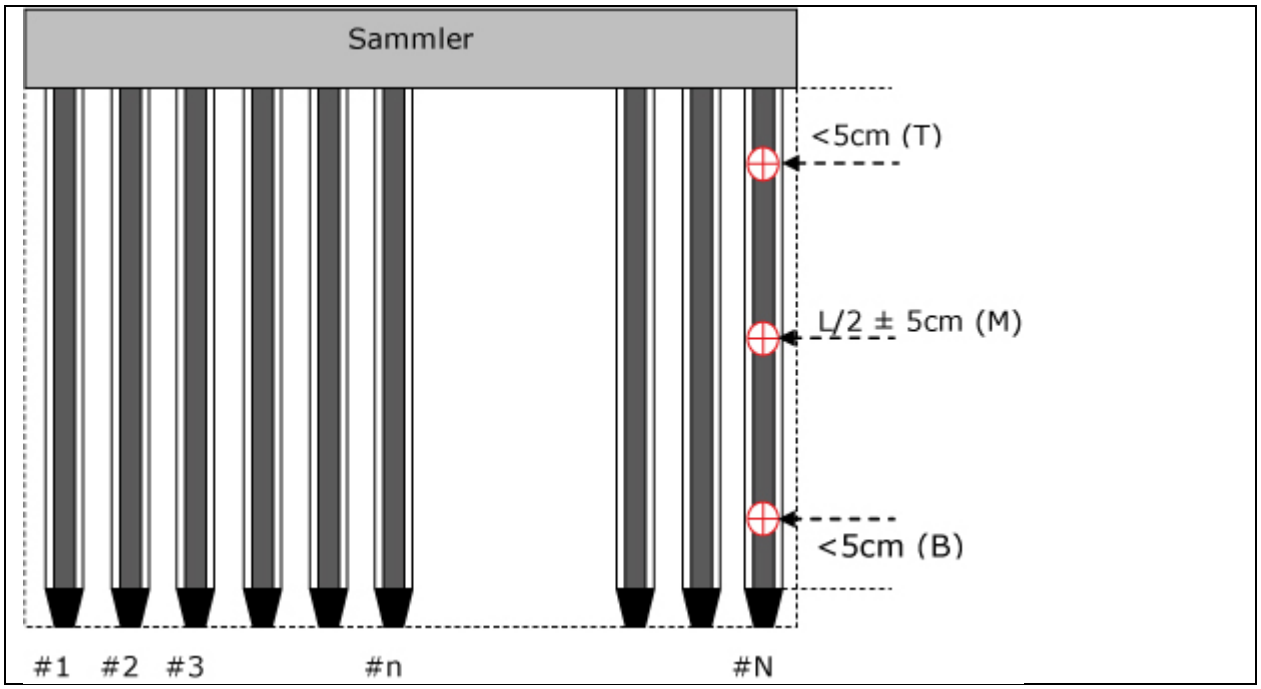
Rapperswil, 29.08.2011

Dr. Andreas Bohren
Head of SPF Testing

August Thrier
Test engineer

Annex A: Definition of the Impact Points

A1 Vacuum Tube Collectors



A2 Flat Plate Collectors