

ISO 9806:2013-11 (E)

Solar energy - Solar thermal collectors - Test methods

Contents	Page
Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	3
5 General	8
5.1 Test overview - Sequence of the tests	8
5.2 Particular aspects of collectors using external power sources and active or passive measures for normal operation and self-protection	9
6 Internal pressure tests for fluid channels	10
6.1 Inorganic fluid channels	10
6.2 Fluid channels made of organic materials (plastics or elastomers)	10
6.3 Apparatus and procedure	10
6.4 Results	11
7 Leakage test (closed loop air heating collectors only)	11
7.1 Objective	11
7.2 Apparatus and procedure	11
7.3 Test conditions	12
7.4 Results	12
8 Rupture or collapse test (air heating collectors only)	12
8.1 Objective	12
8.2 Apparatus and Procedure	13
8.3 Test conditions	14
8.4 Results and reporting	14
9 High-temperature resistance test	14
9.1 Objective	14
9.2 Apparatus and procedure	14
9.3 Test conditions	15
9.4 Results	15
10 Standard stagnation temperature of liquid heating collectors	16
10.1 General	16
10.2 Measurement and extrapolation of standard stagnation temperature	16
10.3 Determining standard stagnation temperature using efficiency parameters	17
10.4 Results	17
11 Exposure and pre-exposure test	18
11.1 Objective	18
11.2 Apparatus and procedure	18
11.3 Test conditions	18
11.4 Results	19

12	External thermal shock test	19
12.1	Objective	19
12.2	Apparatus and procedure	19
12.3	Test conditions	20
12.4	Results	20
13	Internal thermal shock test	20
13.1	Objective	20
13.2	Apparatus and procedure	20
13.3	Test conditions	21
13.4	Results	21
14	Rain penetration test	21
14.1	Objective	21
14.2	Apparatus and procedure	21
14.3	Test conditions	22
14.4	Results	24
15	Freeze resistance test	24
15.1	Objective	24
15.2	Apparatus and procedure	24
15.3	Test conditions	25
15.4	Results	25
16	Mechanical load test with positive or negative pressure	25
16.1	Objectives	25
16.2	Apparatus and procedure	25
16.3	Test conditions	26
16.4	Results	26
17	Impact resistance test	26
17.1	Objective	26
17.2	Test procedure	27
17.3	Impact location	27
17.4	Method 1: Impact resistance test using ice balls	27
17.5	Method 2: Impact resistance test using steel balls	28
17.6	Results	28
18	Final inspection (related to Clauses 5 to 17)	29
19	Test report (related to Clauses 5 to 18)	29
20	Performance testing of fluid heating collectors	29
20.1	General	29
20.2	Steady-state efficiency test using a solar irradiance simulator	30
21	Collector mounting and location	31
21.1	General	31
21.2	Collector frame	31
21.3	Tilt angle	32
21.4	Collector orientation outdoors	32
21.5	Shading from direct solar irradiance	32
21.6	Diffuse and reflected solar irradiance	33
21.7	Thermal irradiance	33
21.8	Surrounding air speed	33
22	Instrumentation	34
22.1	Solar radiation measurement	34
22.2	Thermal radiation measurement	35
22.3	Temperature measurements	37
22.4	Flow rate measurement	39

22.5	Surrounding air speed measurement	40
22.6	Elapsed time measurement	41
22.7	Pressure measurement	41
22.8	Humidity measurement	42
22.9	Collector gross area	42
22.10	Collector fluid capacity	42
23	Test installation	42
23.1	Liquid heating collectors	42
23.2	Air heating collectors	46
24	Performance test procedures	48
24.1	General	48
24.2	Test installation	49
24.3	Preconditioning of the collector	49
24.4	Test conditions	49
24.5	Test procedure	51
24.6	Measurements	52
24.7	Test period	54
24.8	Presentation of results	59
25	Computation of the collector parameters	59
25.1	Liquid heating collectors	59
25.2	Steady-state air heating collectors	63
26	Determination of the effective thermal capacity and the time constant of a collector	64
26.1	Measurement of the effective thermal capacity (separate measurement)	64
26.2	Measurement of the effective thermal capacity (quasi dynamic method)	66
26.3	Calculation method	66
26.4	Determination of collector time constant (optional)	67
27	Determination of incident angle modifier	69
27.1	Modelling	69
27.2	Test procedures	73
27.3	Calculation of collector incidence angle modifier	74
28	Determination of the pressure drop across a collector (Liquid) (optional)	75
28.1	General	75
28.2	Test installation	75
28.3	Preconditioning of the collector	75
28.4	Test procedure	75
28.5	Measurements	76
28.6	Pressure drop caused by fittings	76
28.7	Test conditions	76
28.8	Calculation and presentation of results	77
28.9	Pressure drop for air collectors	77
	Annex A (normative) Test reports	79
	Annex B (informative) Mathematical models for liquid heating collectors	104
	Annex C (normative) Properties of water	108
	Annex D (informative) General guidelines for the assessment of uncertainty in solar collector efficiency testing	111
	Annex E (informative) Measurement of the velocity weighted mean temperature	115
	Bibliography	117