DIN EN ISO 9806:2014-06 (E)

Solar energy - Solar thermal collectors - Test methods (ISO 9806:2013)

Contents

Page

Foreword 5

Introduction 6

1 Scope 7

2 Normative references 7

3 Terms and definitions 7

4 Symbols and abbreviated terms 9

5 General 14
5.1 Test overview - Sequence of the tests 14
5.2 Particular aspects of collectors using external power sources and active or passive measures for normal operation and self-protection 15

6 Internal pressure tests for fluid channels 16
6.1 Inorganic fluid channels 16
6.2 Fluid channels made of organic materials (plastics or elastomers) 16
6.3 Apparatus and procedure 16
6.4 Results 17

7 Leakage test (closed loop air heating collectors only) 17
7.1 Objective 17
7.2 Apparatus and procedure 17
7.3 Test conditions 18
7.4 Results 18

8 Rupture or collapse test (air heating collectors only) 18
8.1 Objective 18
8.2 Apparatus and Procedure 19
8.3 Test conditions 20
8.4 Results and reporting 20

9 High-temperature resistance test 20
9.1 Objective 20
9.2 Apparatus and procedure 20
9.3 Test conditions 21
9.4 Results 21

10 Standard stagnation temperature of liquid heating collectors 22
10.1 General 22
10.2 Measurement and extrapolation of standard stagnation temperature 22
10.3 Determining standard stagnation temperature using efficiency parameters 23
10.4 Results 23

11 Exposure and pre-exposure test 24
11.1 Objective 24
11.2 Apparatus and procedure 24
11.3 Test conditions 24
11.4 Results 25

12 External thermal shock test 25
12.1 Objective 25
12.2 Apparatus and procedure 25
12.3 Test conditions 26
12.4 Results 26

13 Internal thermal shock test 26
13.1 Objective 26
13.2 Apparatus and procedure 26
13.3 Test conditions 27
13.4 Results 27

14 Rain penetration test 27
14.1 Objective 27
14.2 Apparatus and procedure 27
14.3 Test conditions 28
14.4 Results 30

15 Freeze resistance test 30
15.1 Objective 30
15.2 Apparatus and procedure 30
15.3 Test conditions 31
15.4 Results 31

16 Mechanical load test with positive or negative pressure 31
16.1 Objectives 31
16.2 Apparatus and procedure 31
16.3 Test conditions 32
16.4 Results 32

17 Impact resistance test 32
17.1 Objective 32
17.2 Test procedure 33
17.3 Impact location 33
17.4 Method 1: Impact resistance test using ice balls 33
17.5 Method 2: Impact resistance test using steel balls 34
17.6 Results 34

18 Final inspection (related to Clauses 5 to 17) 35

19 Test report (related to Clauses 5 to 18) 35

20 Performance testing of fluid heating collectors 35
20.1 General 35
20.2 Steady-state efficiency test using a solar irradiance simulator 36

21 Collector mounting and location 37
21.1 General 37
21.2 Collector frame 37
21.3 Tilt angle 38
21.4 Collector orientation outdoors 38
21.5 Shading from direct solar irradiance 38
21.6 Diffuse and reflected solar irradiance 39
21.7 Thermal irradiance 39
21.8 Surrounding air speed 39

22 Instrumentation 40
22.1 Solar radiation measurement 40
22.2 Thermal radiation measurement 41
22.3 Temperature measurements 43
22.4 Flow rate measurement 45

22.5 Surrounding air speed measurement 46
22.6 Elapsed time measurement 47
22.7 Pressure measurement 47
22.8 Humidity measurement 48
22.9 Collector gross area 48
22.10 Collector fluid capacity 48

23 Test installation 48
23.1 Liquid heating collectors 48
23.2 Air heating collectors 52

24 Performance test procedures 54
24.1 General 54
24.2 Test installation 55
24.3 Preconditioning of the collector 55
24.4 Test conditions 55
24.5 Test procedure 57
24.6 Measurements 58
24.7 Test period 60
24.8 Presentation of results 65

25 Computation of the collector parameters 65
25.1 Liquid heating collectors 65
25.2 Steady-state air heating collectors 69

26 Determination of the effective thermal capacity and the time constant of a collector 70
26.1 Measurement of the effective thermal capacity (separate measurement) 70
26.2 Measurement of the effective thermal capacity (quasi dynamic method) 72
26.3 Calculation method 72
26.4 Determination of collector time constant (optional) 73

27 Determination of incident angle modifier 75
27.1 Modelling 75
27.2 Test procedures 79
27.3 Calculation of collector incidence angle modifier 80

28 Determination of the pressure drop across a collector (Liquid) (optional) 81
28.1 General 81
28.2 Test installation 81
28.3 Preconditioning of the collector 81
28.4 Test procedure 81
28.5 Measurements 82
28.6 Pressure drop caused by fittings 82
28.7 Test conditions 82
28.8 Calculation and presentation of results 83
28.9 Pressure drop for air collectors 83

Annex A (normative) Test reports 85

Annex B (informative) Mathematical models for liquid heating collectors 110

Annex C (normative) Properties of water 114

Annex D (informative) General guidelines for the assessment of uncertainty in solar collector efficiency testing 117

Annex E (informative) Measurement of the velocity weighted mean temperature 121

Bibliography 123