

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)



BSI Standards Publication

**Solar energy - Solar thermal collectors
- Test methods (ISO 9806:2017)**

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of EN ISO 9806:2017. It is identical to ISO 9806:2017. It supersedes BS EN ISO 9806:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/25, Solar Heating.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018
Published by BSI Standards Limited 2018

ISBN 978 0 580 93683 8

ICS 27.160

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2018.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

EUROPÄISCHE NORM

November 2017

ICS 27.160

Supersedes EN ISO 9806:2013

English Version

Solar energy - Solar thermal collectors - Test methods (ISO 9806:2017)

Énergie solaire - Capteurs thermiques solaires -
Méthodes d'essai (ISO 9806:2017)

Solarenergie - Thermische Sonnenkollektoren -
Prüfverfahren (ISO 9806:2017)

This European Standard was approved by CEN on 29 August 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

European foreword

This document (EN ISO 9806:2017) has been prepared by Technical Committee ISO/TC 180 "Solar energy" in collaboration with Technical Committee CEN/TC 312 "Thermal solar systems and components" the secretariat of which is held by ELOT.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 9806:2013.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 9806:2017 has been approved by CEN as EN ISO 9806:2017 without any modification.

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

Contents

	Page
Foreword	viii
Introduction	ix
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols	2
5 General	5
5.1 Test overview — Sequence of the tests.....	5
5.2 Testing of collectors with specific attributes.....	6
5.2.1 General.....	6
5.2.2 Collectors using external power sources and collectors with active or passive measures for normal operation and self-protection.....	6
5.2.3 Collectors co-generating thermal and electrical power.....	7
5.2.4 Wind and/or infrared sensitive collectors (WISC).....	7
5.2.5 Façade collectors.....	7
5.2.6 Air and liquid heating collectors.....	8
6 Internal pressure tests for fluid channels	8
6.1 Objective.....	8
6.2 Fluid channels made of non-polymeric materials.....	8
6.2.1 Apparatus and procedure.....	8
6.2.2 Test conditions.....	8
6.3 Fluid channels made of polymeric materials.....	8
6.3.1 Apparatus and procedure.....	8
6.3.2 Test conditions.....	9
6.4 Results and reporting.....	9
7 Air leakage rate test (air heating collectors only)	9
7.1 Objective.....	9
7.2 Apparatus and procedure.....	9
7.3 Test conditions.....	10
7.4 Results and reporting.....	10
8 Rupture or collapse test (air heating collectors only)	10
8.1 Objective.....	10
8.2 Apparatus and procedure.....	10
8.2.1 General.....	10
8.2.2 Closed-loop collectors.....	11
8.2.3 Open to ambient collectors.....	11
8.3 Results and reporting.....	11
9 Standard stagnation temperature	11
9.1 Objective.....	11
9.2 Testing under stagnation conditions.....	12
9.3 Measurement and extrapolation of standard stagnation temperature.....	12
9.4 Determining standard stagnation temperature using efficiency parameters.....	12
9.5 Results and reporting.....	13
10 Exposure and half-exposure test	13
10.1 Objective.....	13
10.2 Initial outdoor exposure.....	13
10.3 Method 1.....	14
10.4 Method 2.....	14
10.5 Method 3.....	14
10.6 Test conditions.....	14

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

10.7	Results and reporting.....	15
11	External thermal shock.....	15
11.1	Objective.....	15
11.2	Apparatus and procedure.....	15
11.3	Test conditions.....	15
11.4	Results and reporting.....	16
12	Internal thermal shock test (Liquid heating collectors only).....	16
12.1	Objective.....	16
12.2	Apparatus and procedure.....	16
12.3	Test conditions.....	16
12.4	Results and reporting.....	16
13	Rain penetration test.....	16
13.1	Objective.....	16
13.2	Apparatus and procedure.....	16
13.3	Test conditions.....	17
13.4	Results and reporting.....	19
14	Freeze resistance test.....	19
14.1	Objective.....	19
14.2	Freeze resistant collectors.....	19
	14.2.1 General.....	19
	14.2.2 Test conditions.....	19
14.3	Heatpipe collectors.....	19
	14.3.1 General.....	19
	14.3.2 Test conditions.....	20
	14.3.3 Results and reporting.....	20
15	Mechanical load test with positive or negative pressure.....	20
15.1	Objective.....	20
15.2	Apparatus and procedure.....	20
	15.2.1 Mounting.....	20
	15.2.2 Methods for the application of the loads.....	21
	15.2.3 Particular specifications for tracking collectors or other specific collector types.....	22
15.3	Test conditions.....	22
15.4	Results and reporting.....	22
16	Impact resistance test.....	22
16.1	Objective.....	22
16.2	Test procedure.....	22
16.3	Impact location.....	22
16.4	Method 1: Impact resistance test using ice balls.....	23
	16.4.1 Apparatus.....	23
	16.4.2 Ice balls.....	23
	16.4.3 Specific aspects of the test procedure using ice balls.....	23
16.5	Method 2: Impact resistance test using steel balls.....	23
16.6	Results and reporting.....	24
17	Final inspection.....	24
17.1	Objective.....	24
17.2	Test procedure.....	24
17.3	Results and reporting.....	25
18	Test report.....	25
19	Thermal performance testing.....	25
19.1	General.....	25
19.2	Performance test using a solar irradiance simulator.....	25
	19.2.1 General.....	25
	19.2.2 Solar irradiance simulator for performance testing.....	25
	19.2.3 Solar irradiance simulator for the measurement of incidence angle modifiers.....	26

This is a preview of "BS EN ISO 9806:2017". Click here to purchase the full version from the ANSI store.

20	Collector mounting and location	27
20.1	General	27
20.2	Collector orientation outdoors	27
20.3	Shading from direct solar irradiance	27
20.4	Diffuse and reflected solar irradiance	27
20.5	Thermal irradiance	28
20.6	Surrounding air speed	28
21	Instrumentation	28
21.1	Solar radiation measurement	28
21.1.1	Pyranometer	28
21.2	Thermal radiation measurement	29
21.2.1	General	29
21.2.2	Measurement of thermal irradiance outdoors	29
21.2.3	Measurement of thermal irradiance indoors	29
21.3	Temperature measurements	29
21.3.1	General	29
21.3.2	Heat transfer fluid temperatures (Liquid heating collectors)	29
21.3.3	Volume flow weighted mean temperature $\vartheta_{m,th}$ (Air heating collectors)	30
21.3.4	Measurement of ambient air temperature	30
21.4	Flow rate measurement	31
21.4.1	Measurement of mass flow rate (liquid)	31
21.4.2	Measurement of collector fluid flow rate (Air heating collectors)	31
21.5	Measurement of air speed over the collector	31
21.5.1	General	31
21.5.2	Required accuracy	32
21.6	Elapsed time measurement	32
21.7	Humidity measurement (Air collectors)	32
21.8	Collector dimensions	32
22	Test installation	32
22.1	Liquid heating collectors	32
22.1.1	General	32
22.1.2	Heat transfer fluid	33
22.1.3	Pipe work and fittings	33
22.1.4	Pump and flow control devices	34
22.2	Air heating collectors	34
22.2.1	General	34
22.2.2	Closed loop test circuit	34
22.2.3	Open to ambient test circuit	35
22.2.4	Heat transfer fluid	35
22.2.5	Test ducts	35
22.2.6	Fan and flow control devices	36
22.2.7	Air preconditioning apparatus	36
22.2.8	Humidity ratio	36
23	Thermal performance test procedures	36
23.1	General	36
23.2	Preconditioning of the collector	37
23.3	Test conditions	37
23.3.1	General	37
23.3.2	Flow rates	37
23.3.3	Steady-state method	37
23.3.4	Quasi dynamic test	38
23.4	Test procedure	38
23.4.1	General	38
23.4.2	Steady-state testing of liquid heating collector	38
23.4.3	Steady-state testing of air heating collectors	38
23.4.4	Steady-state testing of WISC collectors	39
23.4.5	Quasi dynamic testing	39

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

23.5	Measurements	39
23.5.1	General	39
23.5.2	Additional measurements during tests in solar irradiance simulators	40
23.5.3	Data acquisition requirements	40
23.6	Test period	40
23.6.1	Steady-state testing	40
23.6.2	Quasi dynamic testing	41
24	Computation of the collector parameters	44
24.1	Liquid heating collectors	44
24.1.1	General	44
24.1.2	Steady-state test method for liquid heating collectors	45
24.1.3	Quasi dynamic test method for liquid heating collectors	45
24.1.4	Data analysis	45
24.2	Air heating collectors	46
24.2.1	General	46
24.2.2	Steady-state test method for closed loop air heating collectors	46
24.2.3	Steady-state test method for open to ambient air heating collectors	46
24.2.4	Steady-state test method for open to ambient air heating WISC collectors	46
24.3	Standard reporting conditions (SRC)	46
24.4	Standard uncertainties	47
24.5	Reference area conversion	47
25	Determination of the effective thermal capacity and the time constant	47
25.1	General	47
25.2	Measurement of the effective thermal capacity with irradiance	47
25.3	Measurement of the effective thermal capacity using the quasi dynamic method	48
25.4	Calculation method for the determination of the effective thermal capacity	48
25.5	Determination of collector time constant	48
26	Determination of the incident angle modifier (IAM)	49
26.1	General	49
26.2	Modelling	50
26.2.1	Steady-state	51
26.2.2	Quasi dynamic	52
26.3	Test procedures	52
26.3.1	Steady-state liquid heating collectors	52
26.3.2	Air collectors	52
26.4	Calculation of the collector incidence angle modifier	53
26.5	Reporting	53
27	Determination of the pressure drop	53
27.1	General	53
27.2	Liquid heating collectors	53
27.2.1	Apparatus and procedure	53
27.2.2	Pressure drop caused by fittings	54
27.2.3	Test conditions	54
27.3	Air heating collectors	54
27.3.1	Apparatus and procedure	54
27.4	Calculation and presentation of results	55
	Annex A (normative) Test reports	56
	Annex B (normative) Steady-state and quasi dynamic model	80
	Annex C (normative) Density and heat capacity of water	81
	Annex D (informative) Assessment of the standard uncertainty in solar collector testing	82
	Annex E (informative) Measurement of the velocity weighted mean temperature	86
	Annex F (informative) Material efficiency aspects	88
	Annex G (informative) Area conversion of thermal performance parameters	89

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

Bibliography	90
---------------------------	-----------

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 312, *Thermal solar systems and components*, in collaboration with ISO Technical Committee TC 180, *Solar energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition ISO 9806:2013, which has been technically revised.

This is a preview of "BS EN ISO 9806:2017". [Click here to purchase the full version from the ANSI store.](#)

Introduction

This document defines procedures for testing fluid heating solar collectors for thermal performance, reliability, durability and safety under well-defined and repeatable conditions. It contains performance test methods for conducting tests outdoors under natural solar irradiance and natural and simulated wind and for conducting tests indoors under simulated solar irradiance and wind. Outdoor tests can be performed either steady-state or as all-day measurements, under changing weather conditions.

Collectors tested according to this document represent a wide range of applications, e.g. glazed flat plate collectors and evacuated tube collectors for domestic water and space heating, collectors for heating swimming pools or for other low temperature systems or tracking concentrating collectors for thermal power generation and process heat applications. This document is applicable to collectors using liquids, as well as air as heat transfer fluid. Similarly, collectors using external power sources for normal operation and/or safety purposes (overheating protection, environmental hazards, etc.), as well as hybrid devices generating thermal power and electrical power are also considered.

This is a preview of "BS EN ISO 9806:2017". Click here to purchase the full version from the ANSI store.

Solar energy — Solar thermal collectors — Test methods

1 Scope

This document specifies test methods for assessing the durability, reliability, safety and thermal performance of fluid heating solar collectors. The test methods are applicable for laboratory testing and for *in situ* testing.

This document is applicable to all types of fluid heating solar collectors, air heating solar collectors, hybrid solar collectors co-generating heat and electric power, as well as to solar collectors using external power sources for normal operation and/or safety purposes. It does not cover electrical safety aspects or other specific properties directly related to electric power generation.

This document is not applicable to those devices in which a thermal storage unit is an integral part to such an extent that the collection process cannot be separated from the storage process for making the collector thermal performance measurements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9060, *Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation*

ISO 9488, *Solar energy — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9488 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

longitudinal plane

plane defined by the normal to the plane of the collector and the concentrator axis, or the largest symmetry line for flat biaxial geometries

3.2

maximum operating temperature

maximum temperature allowed during collector or system normal operation specified by the manufacturer

3.3

outgassing

process in which any material releases gases when it is exposed to elevated temperatures and/or reduced pressure