
**Solar energy — Collector components
and materials —**

**Part 2:
Heat-pipes for solar thermal
application — Durability and
performance**

Énergie solaire — Composants et matériaux du collecteur —

*Partie 2: Caloduc pour application thermique solaire — Durabilité et
performance*

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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).

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For an explanation on 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.

The committee responsible for this document is ISO/TC 180, *Solar energy*.

ISO 22975 consists of the following parts, under the general title *Solar energy — Collector components and materials*:

- *Part 1: Evacuated tube — Durability and performance*
- *Part 2: Heat-pipes for solar thermal application — Durability and performance*
- *Part 3: Absorber surface durability*

The following parts are under preparation:

- *Part 5: Insulation material durability and performance*

Introduction

This part of ISO 22975 specifies test methods for durability and performance of heat-pipes for solar thermal application.

This part of ISO 22975 is applicable to all heat-pipes for use with both evacuated tubes and flat plate collectors.

For each durability and performance test, its objective, principle, test condition, apparatus, procedure and test results are specified.

For all the tests specified in this part of ISO 22975, a complete heat-pipe is required.

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Solar energy — Collector components and materials —

Part 2:

Heat-pipes for solar thermal application — Durability and performance

1 Scope

This part of ISO 22975 specifies definitions and test methods for durability and performance of heat-pipes for solar thermal application.

This part of ISO 22975 is applicable to heat-pipes for use with evacuated tubes, including glass-metal sealed evacuated tubes and double-glass evacuated tubes, as well as with flat plate collectors.

This part of ISO 22975 provides test methods for determining durability of the heat-pipe, including high temperature resistance and freeze resistance.

This part of ISO 22975 also provides test methods for measuring performance of the heat-pipe, including starting temperature, temperature uniformity and heat transfer power of the heat-pipe.

This part of ISO 22975 is only applicable to gravity heat-pipes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9488, *Solar energy — Vocabulary*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

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

3.1

heat-pipe

heat transfer element, utilizing latent heat of phase-change for heat transfer

3.2

gravity heat-pipe

heat-pipe (3.1) without a capillary wick inside, in which the liquefied *working fluid* (3.6) returns from *condenser* (3.4) to *evaporator* (3.3) due to its own weight

3.3

evaporator

part of a *heat-pipe* (3.1), where the liquefied *working fluid* (3.6) absorbs heat, vaporizes and becomes the vaporized working fluid

3.4

condenser

part of a *heat-pipe* (3.1), where the vaporized *working fluid* (3.6) releases heat, condenses and becomes the liquefied working fluid

3.5

adiabatic section

part of a *heat-pipe* (3.1), located between *evaporator* (3.3) and *condenser* (3.4), where *working fluid* (3.6) has minimal heat exchange with the surroundings

3.6

working fluid

medium used for heat transfer in a *heat-pipe* (3.1)

3.7

tilt angle (of heat-pipe)

angle between the horizontal plane and a *heat-pipe* (3.1)

3.8

starting temperature of heat-pipe

minimum temperature required for a *heat-pipe* (3.1) to start operating

3.9

temperature uniformity of heat-pipe

temperature difference between *evaporator* (3.3) and *condenser* (3.4) when a *heat-pipe* (3.1) operates under normal conditions

3.10

heat transfer power of heat-pipe

thermal power transferred to the cooling liquid from a *heat-pipe* (3.1) when using the cooling liquid to remove heat

3.11

stable conditions

conditions in performance tests of a *heat-pipe* (3.1), in which the temperature variation is less than ± 1 K over a period depending on the performance test item

4 Test overview

Durability tests and performance tests for heat-pipes are specified in [Clause 5](#) and [Clause 6](#), respectively. The tests shall be performed in the sequence according to [Table 1](#).

All these tests shall be performed on the same heat-pipes.

Table 1 — Test list

Clause	Test
5.1	High temperature resistance test
5.2	Freeze resistance test ^a
6.1	Starting temperature of heat-pipes
6.2	Temperature uniformity of heat-pipes
6.3	Heat transfer power of heat-pipes ^b
^a The freeze resistance test shall be carried out only for heat-pipes claimed to be freeze resistant.	
^b The heat transfer power test shall be performed after the high temperature resistance test.	

5 Durability

5.1 High temperature resistance test

5.1.1 Objective

This test is intended to assess the capability of a heat-pipe to withstand high temperature without failure.

5.1.2 Test conditions

The test shall be carried out under the following conditions:

- a) test environment: indoors;
- b) ambient temperature: 15 °C to 35 °C;
- c) test temperature in heating chamber: 180 °C $\pm$ 5 °C or 230 °C $\pm$ 5 °C or 280 °C $\pm$ 5 °C depending on specific application and manufacturer's declaration;
- d) tilt angle of heat-pipe: 90° $\pm$ 1°.

The test may be conducted at any higher heating chamber temperature, if requested.

5.1.3 Apparatus

The test apparatus consists of a heating chamber and a thermometric system.

Measuring instruments shall meet the following requirements:

- a) heating chamber temperature controller, with an accuracy of $\pm 0,5$ K;
- b) ambient temperature sensor; standard uncertainty shall not be more than $\pm 0,5$ K;
- c) digital clock/data acquisition system; standard uncertainty shall not be more than ± 10 s/d.

5.1.4 Procedure

The test shall be carried out for a batch of at least 10 sample heat-pipes of the same product.

The procedure shall be as follows.

- a) Place all sample heat-pipes into the heating chamber at the specified tilt angle.
- b) Increase the temperature in the heating chamber slowly (maximum 20 K/min) up to the selected test temperature.
- c) Maintain the test temperature for 30 h.
- d) After the heat-pipes have cooled to room temperature, visually inspect for damage, such as leakage, breakage, distortion or deformation.

5.1.5 Results

The product will be qualified if there is no visual evidence of damage to the heat-pipes.

Results of the inspection shall be reported together with ambient temperature, test temperature in heating chamber and test duration.