INTERNATIONAL STANDARD

ISO 22975-4

First edition
2023-07

Solar energy — Collector components and materials —

Part 4:
Glazing material durability and performance

Energie solaire — Composants et matériaux du capteur —

Partie 4: Durabilité et performance des matériaux de vitrage

Reference number
ISO 22975-4:2023(E)

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 180, *Solar Energy*.

A list of all parts in the ISO 22975 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Solar energy — Collector components and materials —

Part 4:
Glazing material durability and performance

1 Scope

This document specifies definitions and test methods for glazing material durability and performance.

This document is applicable to those collectors having a glazing to fit sheets or tubes of glass into collectors; accordingly, soda lime silicate glass and borosilicate glass are used.

This document is applicable to solar transmittance of glass for solar collector.

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 9488, *Solar energy — Vocabulary*

ISO 22975-1, *Solar energy — Collector components and materials — Part 1: Evacuated tubes — Durability and performance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9488, ISO 22975-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org

3.1
specimen
general term applied to test glass samples of flat plate and tube

3.2
solar transmittance
τ_s
fraction of solar radiation energy transmitted by a piece of glass in the solar energy wavelength range of 0,3 µm to 2,5 µm for air mass 1,5 (AM1,5)

3.3
solar glass
transmittance of a piece of glass without treatment above 0,850 for air mass 1,5 (AM1,5) is called solar glass

3.4
thermal shock
sudden change in temperature applied to *specimens* (3.1)

3.5
thermal shock resistance
thermal shock resistance of *specimens* (3.1) in temperature difference, in which less than a specified percentage of the specimens will probably fail

3.6
thermal shock endurance
thermal shock endurance of *specimens* (3.1) in temperature difference, in which less than a specified percentage of the specimens will probably fail

4 Classification of solar glass

4.1 General

Solar glass divides into three types: untreated solar glass, single-side anti-reflex (AR) treated solar glass and double-side anti-reflex (AR) treated solar glass.

4.2 Solar transmittance of untreated glass

Solar transmittance of untreated glass is shown in Table 1.

4.3 Solar transmittance of single-side AR treated glass

Solar transmittance of single-side AR treated glass is shown in Table 2.

4.4 Solar transmittance of double-side AR treated glass

Solar transmittance of double-side AR treated glass is shown in Table 3.

Table 1 — Classification of untreated glass

Classification	τ_s (AM1,5)
Class U1	0,900
Class U2	0,885
Class U3	0,870

Table 2 — Classification of single-side AR treated glass

Classification	τ_s (AM1,5)
Class S1	0,925
Class S2	0,910
Class S3	0,895

Table 3 — Classification of double-side AR treated glass

Classification	τ_s (AM1,5)
Class D1	0,950
Class D2	0,935
Class D3	0,920

5 Test methods for assessing material optical property of the glass

5.1 Preparation of test specimens

Preparation of test specimens for the cover glass, a cover glass area of at least 80 × 80 mm shall be prepared. For tubes, test specimens of tube fragments of 56 mm, 58 mm or the applicable diameter with a length of 200 mm shall be prepared. For execution of the complete programme of solar transmittance tests of this recommended procedure, a minimum of 5 test specimens are required.

5.2 Measurements of solar transmittance

The values of the solar transmittance for each of the 5 test specimens are determined using an UV-VIS-NIR spectrophotometer with integrating sphere, which shall be in accordance with Annex A. For the complete set of test specimens, the mean value of solar transmittance is obtained, and then the uncertainty of the solar transmittance is calculated.

6 Tests for assessing the thermal stability of the glass

6.1 Apparatus

6.1.1 Hot oven

Hot oven with electric heating and temperature sensor.

— the inside space of hot oven is large enough for mounting the basket with specimens

— minimum temperature not less than 400 °C, temperature stability ±3 °C.

6.1.2 Cold bath

Cold bath with water and temperature sensor.

— the inside space of cold bath is large enough for placing the basket with specimens.

— cold bath with water in the temperature range of 25 °C ± 5 °C, temperature stability ±3 °C.

6.1.3 Basket

Basket shall be capable of holding the specimens upright and separate, and shall be fitted with a perforated lid to prevent the specimens floating when immersed.

6.2 Specimens

6.2.1 Flat plate glass

10 of specimen plates of flat plate glass with finished edges, the plate size should be at least 80 mm × 80 mm.

6.2.2 Tube glass

10 of specimen of tube fragments,

EXAMPLE The tube diameter of Ø56 mm or Ø58 mm, and 150 mm to 200 mm length.

6.3 Procedure

6.3.1 Ambient temperature

Ambient temperature should be in the range of 18 °C to 28 °C during the thermal stability tests.

6.3.2 The hot oven

The hot oven has the space for mounting the basket with test specimens, and then it is heated to maintain the upper temperature, T_1, °C within ±5 °C.

6.3.3 The cold bath

Fill the cold bath with water to a volume equal to a depth sufficient for complete immersion of the specimens plus at least 50 mm. Adjust the water temperature to the specified lower temperature, T_2, °C, ±5 °C.

6.3.4 Heating the specimens

Placing the specimens in the basket so that they are held upright and separated in the hot oven, keep the specimens in specified upper temperature, T_1 at least 30 min.

6.3.5 Cooling the specimens

Transfer the basket with filled specimens, either mechanically or manually within max. 6 s from the hot oven to the cold bath, so that the specimens are completely immersed. Keep the basket immersed for 30 s, then remove the basket and its contents from the cold bath.

6.3.6 Results

Determine as soon as possible the number of specimens which have failed the test, by inspecting each one for cracks or breakage.

7 Thermal shock resistance

7.1 Test specimens

Test specimens of glass shall be annealed, and shall use newly identical glasses in various tests at temperature difference T_1 - T_2, *K.*

7.2 Temperature difference

The temperature difference T_1 - T_2 is increased in 20 K increment for soda lime silicate glass, and the temperature difference T_1 - T_2 is increased in 50 K increment for tubes of borosilicate glass 3.3, which shall be in accordance with Annex B.1 and B.2; Specified T_2 at 25 °C ± 5 °C, temperature stability ±3 °C.

7.3 Pass the test

The agreed number of thermal shock resistance shall be specimens of no more than 20 % cracks after being subjected to a temperature difference of the thermal shock of $\Delta T = T_1 - T_2$, *K.*

7.4 Progressive test

Progressive test until specimens of 20 % cracks after being subjected to a temperature difference of the thermal shock of $\Delta T = T_1 - T_2$, K.

7.5 High-level test

Specimens shall be tested at a temperature difference, $T_1 - T_2$, K which causes all the specimens to fail in a single test.

8 Thermal shock endurance

The thermal endurance, which is the probable temperature difference at which 50 % of the specimens would have failed, is determined from a graph of the cumulative percentage of failures against the temperature difference at which the specimens failed.

9 Report

The test report shall include the following:

a) a reference to this document, i.e. ISO 22975-4:2023;

b) Number of specimens in the test and method;

c) Temperature of the hot oven, °C;

d) Temperature of the cold bath, °C;

e) Test results:

1) for the pass test, in accordance with 7.3:

- — temperature difference, $T_1 - T_2$, K;
- — number of specimens failed in the test;
- — specification limit and whether the number of the specimens passed the test.

2) for the progressive test, in accordance with 7.4:

- — highest temperature difference, $T_1 - T_2$, K at which no failure occurred;
- — number of specimens which failed at each temperature difference;
- — temperature difference needed to achieve the predetermined percentage of failures, expressed to the nearest increment step;

3) for the high-level test, in accordance with 7.5:

- — temperature difference $T_1 - T_2$, K, used in the test;
- — percentage of specimens which failed at that temperature difference

4) for the thermal shock endurance test, in accordance with Clause 8:

- — temperature difference $T_1 - T_2$, K, at which 50 % fail of the specimen would have failed

e) Date of test;

f) Location;

g) Signature of responsible person.

Annex A
(normative)

Assessment of solar transmittance of solar glass

A.1 Procedure

This procedure specifies a method for determination of the directional solar transmittance, from spectral directional transmittance in the spectral range of 0,30 µm – 2,5 µm at room temperature.

A.2 Apparatus

Spectral directional transmittance by use of a spectrophotometer.

A.3 Measurement

Measurement of transmittance values, solar transmittance shall be assessed by use of the weighted ordinates method; The transmittance shall be measured at least 40 wavelengths in the range 0,30 µm to 2,50 µm.

A.4 Evaluation

Evaluation of solar transmittance. The solar transmittance, τ_s, is calculated from the following expression:

$$\tau_s = \frac{\Sigma_i \tau(\lambda_i) S\lambda_i \, \Delta\lambda_i}{\Sigma_i S\lambda_i \, \Delta\lambda_i}$$

where

λ_i is the set of the selected measuring wavelengths;

$\Delta\lambda_i$ is the respective wavelength interval;

$S\lambda_i$ is the global spectral solar irradiance.

A.5 Mean solar transmittance and the uncertainty

The mean solar transmittance is obtained, and then the uncertainty of solar transmittance is calculated.

