
**Glass in building — Laminated glass and
laminated safety glass —**

Part 4:
Test methods for durability

*Verre dans la construction — Verre feuilleté et verre feuilleté de sécurité —
Partie 4: Méthodes d'essai concernant la durabilité*



Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12543-4 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 160, *Glass in building*, Subcommittee SC 1, *Product consideration*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 12543 consists of the following parts, under the general title *Glass in building — Laminated glass and laminated safety glass*:

- *Part 1: Definitions and description of component parts*
- *Part 2: Laminated safety glass*
- *Part 3: Laminated glass*
- *Part 4: Test methods for durability*
- *Part 5: Dimensions and edge finishing*
- *Part 6: Appearance*

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Foreword

The text of EN ISO 12543-4:1998 has been prepared by Technical Committee CEN/TC 129 "Glass in building", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 160 "Glass in building".

This part of the standard is one of a series of interrelated parts:

- EN ISO 12543-1: Glass in building - Laminated glass and laminated safety glass - Part 1: Definitions and description of component parts
- EN ISO 12543-2: Glass in building - Laminated glass and laminated safety glass - Part 2: Laminated safety glass
- EN ISO 12543-3: Glass in building - Laminated glass and laminated safety glass - Part 3: Laminated glass
- EN ISO 12543-4: Glass in building - Laminated glass and laminated safety glass - Part 4: Test methods for durability
- EN ISO 12543-5: Glass in building - Laminated glass and laminated safety glass - Part 5: Dimensions and edge finishing
- EN ISO 12543-6: Glass in building - Laminated glass and laminated safety glass - Part 6: Appearance

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of an identical text or by endorsement, at the latest by November 1998 and conflicting national standards shall be withdrawn at the latest by November 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Standard specifies test methods in respect of resistance to high temperature, humidity and radiation for laminated glass and laminated safety glass for use in building.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

prEN 410 Glass in building - Determination of luminous and solar characteristics of glazing

3 Test specimens

Test specimens should be representative of standard production. Test specimens should either be specially manufactured to the test size or be cut from larger panes. Test specimen with cut edges should contain at least one edge from the original pane from which it was cut.

If the final product has all its edges sealed/protected then the test specimen should also have all its edges sealed/protected.

The method of supporting the test specimen shall not cover two edges of the test specimen. If the test specimen is cut from a larger pane at least one original edge shall not be covered.

Inspect the samples prior to the test at a distance between 30 cm and 50 cm in front of a white diffuse background. Only samples free of faults (bubbles, delamination, cloudiness) shall be used for the test.

4 High temperature test

4.1 Principle

The purpose of this test is to determine whether the laminated glass and laminated safety glass will withstand exposure to high temperatures over an extended period of time without its properties becoming substantially altered. The change in properties is judged by the occurrence of bubbles, delamination and cloudiness (not discolouration).

4.2 Size and number of test specimens

The test specimens shall not be smaller than 300 mm x 100 mm. There shall be three test specimens.

4.3 Procedure

Heat the three test specimens to a temperature of 100_{-3}°C . Maintain this

temperature for a period of 2 h, then allow the test specimens to cool to room temperature.

If the test specimens have both external surfaces of glass the test may be carried out by immersing the test specimens vertically in water heated up to 100_{-3}°C

To avoid extreme thermal stresses leading to crack formation the specimens should be heated up in two steps by first immersing it into a water bath of about 60°C for 5 min.

4.4 Expression of results

Inspect the samples at a distance between 30 cm and 50 cm in front of a white diffuse background.

Record the number and extent of the faults occurring in the interlayer (bubbles, delamination, cloudiness, not discolouration) for each test specimen. Disregard all faults within 15 mm from an original edge and 25 mm from a cut edge. Individual bubbles in the immediate vicinity of inlaid wires are permissible.

A sample showing cracks shall be disregarded and another test specimen shall be tested in its place.

Delamination taken as a criterion for evaluation after the high temperature and the humidity test, may be described as essentially two dimensional phenomena, in the interface between the glass and the interlayer, in which area no adhesion exists.

4.5 Test report

The following information shall be given in the test report:

- a) type and structure of the laminated glass or laminated safety glass, with nominal thickness of the individual constituents in millimetres;
- b) type of test specimens including cut or special manufacture; type of edge; edge protection; dimensions;
- c) unsupported and supported edges by the test frame;
- d) for each test specimen the number and size of the bubbles, delamination and cloudiness (not discolouration) occurring.

5 Humidity tests

5.1 Principle

The purpose of this test is to determine whether the laminated glass and laminated safety glass will withstand the effects of humidity in the atmosphere over an extended period of time without its properties becoming substantially altered. The effects of the humidity to be judged are bubbles, delamination and cloudiness (not discolouration).

5.2 Size and number of test specimens

The test specimens shall not be smaller than 300 mm x 100 mm. There shall be three test specimens.

5.3 Procedure

5.3.1 Test with condensation

Keep the three test specimens vertically for two weeks over water in a closed container. Maintain the temperature of the air in the container within the limits of 50^{+2}_{0} °C

Adequate spacing between the test specimens shall be provided.

NOTE: These conditions give a relative humidity of about 100% and will lead to water condensation on the surface of the test specimen.

5.3.2 Test without condensation

Put the three test specimens vertically for two weeks into a climate chamber and keep the temperature within the limits of 50^{+2}_{0} °C and the relative humidity within the limits of $(80 \pm 5)\%$. Adequate spacing between the test specimens shall be provided.

5.4 Expression of results

Inspect the samples at a distance between 30 cm and 50 cm in front of a white diffuse background.

Record the number and extend of the faults occurring in the interlayer (bubbles, delamination, cloudiness, not discolouration) for each test specimen. Disregard all faults within 15 mm for an original edge, 25 mm from a cut edge or 10 mm from any crack. Individual bubbles in the immediate vicinity of inlaid wires are permissible. In the case of fire resistant laminated glass and fire resistant laminated safety glass only delaminations shall be considered.

NOTE: The interlayers of fire resistant laminated glass and fire resistant laminated safety glass are designed to react at high temperatures. The exposure of test specimens of those glasses to the temperature reached in the humidity test over a long period of time may create bubbles and cloudiness in the interlayer which do not affect the fire resistant properties so that only delamination will be considered.

5.5 Test report

The following information shall be given in the test report:

- a) test procedure (5.3.1 or 5.3.2);
- b) type and structure of the laminated glass or laminated safety glass, with nominal thickness of the individual constituents in millimetres;
- c) type of test specimens including cut or special manufacture; type of edge; edge protection; dimensions;
- d) unsupported and supported edges by the test frame;
- e) for each test specimen the number and size of the bubbles, delamination and cloudiness occurring (not discolouration).
In the case of fire resistant laminated safety glass and fire resistant laminated glass only delamination shall be given.

6 Radiation test

6.1 Principle

The purpose of this test is to determine whether exposure of laminated glass or laminated safety glass to radiation over an extended period of time produces any appreciable change in its properties. The change in its properties is judged by a change in luminous transmittance and the occurrence of bubbles, delamination and cloudiness (not discolouration).

6.2 Exposure procedure to simulated solar radiation

6.2.1 Radiation source

A radiation source which emits a spectrum similar to solar radiation shall be used. Such a spectral distribution can be obtained by lamps which consist of a combination of a high pressure mercury vapour lamp with an incandescent tungsten filament.

To obtain reproducible and comparable test results suitable lamps shall show the following spectral characteristics:

UVB	(280 nm to 315 nm)	3% ± 1%
UVA	(315 nm to 380 nm)	8% ± 1%
visible range	(380 nm to 780 nm)	18% ± 1%
IRA	(780 nm to 1400 nm)	24% ± 2%
IRB	(1400 nm to 2600 nm)	27% ± 4%
IRC	(> 2600 nm)	20% ± 3%

6.2.2 Test conditions

The exposure time for the radiation test shall be 2000 h.

The temperature of the test specimen shall be maintained at 45°C ± 5°C.

The lamps have to be replaced when their irradiance level in the UVA decreases by more than 50%.

The total irradiance level in the plane of the test samples shall be $900 \text{ W/m}^2 \pm 100 \text{ W/m}^2$.

NOTE: For the determination of the total irradiance level, pyranometers according to the specifications laid down in ISO 9060 and a (limited) sensitivity to the spectral range from 305 nm to 2800 nm may be used. Using these radiation detectors the measured irradiance level in the plane of the test samples will be $730 \text{ W/m}^2 \pm 80 \text{ W/m}^2$.

6.2.3 Arrangement of test apparatus

The test samples are mounted vertically in front of the radiation array. The radiation array consists of lamps uniformly separated to give the optimum radiation density in the plane of the test specimens. The minimum distance between the array of the test specimens and the bottom of the test room shall be 400 mm and the air space behind the array shall be at least 500 mm (to obtain undisturbed free natural convection upwards).

In order to obtain a sufficiently uniform irradiance level the area covered by the test specimens shall not exceed the area of the lamp array A given by the relation

$$A = n \times l_1^2$$

where

n = number of lamps

l_1 = distance between the axes of neighbouring lamps

Informative annex A shows a possible arrangement of the test apparatus

6.3 Size and number of test specimens

The size of the test specimens shall be 300 mm x 300 mm. There shall be three test specimens.

6.4 Procedure

When needed according to 6.5, determine the luminous transmittance of the three test specimens before exposure according to prEN 410.

Orientate the test specimens so that, if there is a designated outer surface, it faces the lamp array. Asymmetric laminated glass, which does not have a designated outer surface, shall be tested both ways round.

After exposure, determine the luminous transmittance of each test specimen once again according to prEN 410.

6.5 Expression of results

6.5.1 Laminated glass and laminated safety glass

If the initial light transmittance was $> 20\%$ compare the results of the luminous transmittance measurement of each exposed test specimen with the values obtained for the same test specimen before exposure. Express the deviation as a percentage. If the initial luminous transmittance was $\leq 20\%$, give the difference between initial and final light transmittance.

Inspect the samples at a distance between 30 cm and 50 cm in front of a white diffuse background. Record the number and extent of delamination occurring in the interlayer for each test specimen. Disregard all delamination within 15 mm from an original edge or 25 mm from a cut edge.

6.5.2 Fire resistant laminated glass and fire resistant laminated safety glass

Inspect the samples at a distance between 30 cm and 50 cm in front of a white diffuse background. Record the number and extent of delamination occurring in the interlayer for each test specimen. Disregard all delamination within 15 mm from an original edge or 25 mm from a cut edge.

NOTE: The interlayers of fire resistant laminated glass and fire resistant laminated safety glass are designed to react at high temperatures. The exposure of test specimens of those glasses to the temperature reached in the radiation test over a long period of time may create bubbles and cloudiness in the interlayer which do not affect the fire resistant properties so that only delamination will be considered.

6.6 Test report

The following information shall be given in the test report:

- a) type and structure of the laminated glass or laminated safety glass, with nominal thickness of the individual constituents in millimetres;
- b) type of test specimens including cut or special manufacture; type of edge; edge protection; dimension;
- c) specification of the radiation source;
- d) in the case of an asymmetric product the face of the product exposed to the radiation;
- e) for products with initial light transmittance $> 20\%$: for each test specimen the percentage difference in the light transmittance before and after radiation;
for products with initial light transmittance $\leq 20\%$: for each test specimen the actual difference in light transmittance before and after radiation;
In the case of fire resistant laminated glass and fire resistant laminated safety glass this difference has not to be given.

- f) for each test specimen the number and extent of delamination occurring

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Annex A (informative)

Possible arrangement of the test apparatus for the radiation test

As radiation sources OSRAM lamps type Ultra-Vitalux ¹⁾ 300 W are used. At least 16 lamps are arranged in a square of 4 x 4 lamps with a distance of $l_1 = 250$ mm between the lamps forming a radiation field of 1 m x 1 m.

The lamp array is framed by an aluminium foil of width $l_3 = 1000$ mm with a specular reflective surface. The distance between the aluminium foil and the outer row of lamps on each side is $l_4 = 125$ mm. The angle α between the plane of the radiation field and the aluminium foil is 100° . The test samples are placed in a parallel plane facing the lamp array at a distance of $l_2 = 1100$ mm forming an area of 1 m x 1 m (see figure 1).

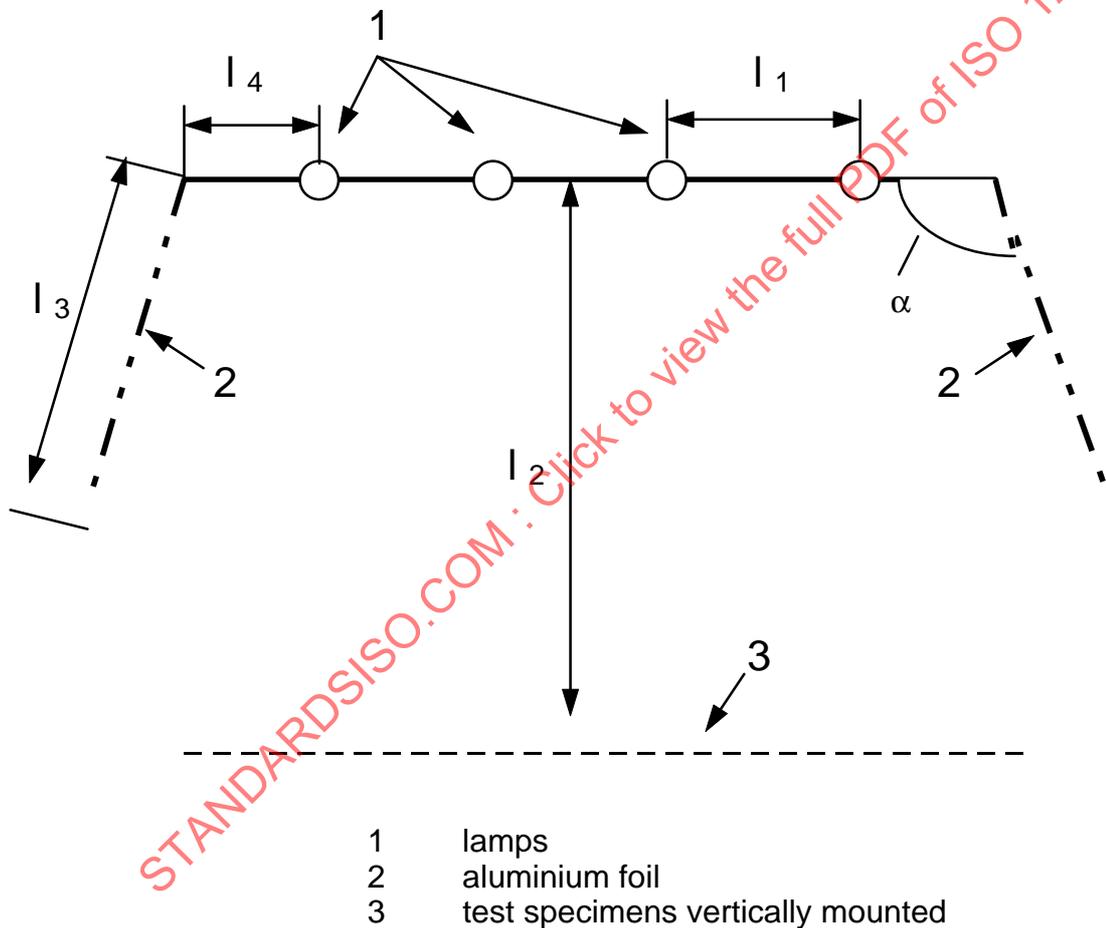


Figure 1: Arrangement for the radiation test (plan view)

¹⁾ Ultra-Vitalux ® is the trade-name of a product supplied by OSRAM in Mercurius straat 28, B-1930 Nossegem or in Steinerne Furt 62, D-86167 Augsburg. This information is given for the convenience of users of this standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.