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Road vehicles — Safety glazing materials — Mechanical tests

Véhicules routiers — Vitrages de sécurité — Essais mécaniques

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 35, *Lighting and visibility*.

This fourth edition cancels and replaces the third edition (ISO 3537:1999), which has been technically revised.

Road vehicles — Safety glazing materials — Mechanical tests

1 Scope

This International Standard specifies mechanical test methods relating to the safety requirements for all safety glazing materials in a road vehicle, whatever the type of glass or other material of which they are composed.

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 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 3536, *Road vehicles — Safety glazing materials — Vocabulary*

ISO 15082, *Road vehicles — Tests for rigid plastic safety glazing materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3536 apply.

4 Test conditions

Unless otherwise specified, the tests shall be carried out under the following conditions:

— Ambient temperature: 20 °C ± 5 °C;

— Atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar);

— Relative humidity: (60 ± 20) %.

5 Application of tests

For certain types of safety glazing materials, it is not necessary to carry out all the tests specified in this International Standard.

6 227 g ball test

Rigid plastic safety glazing materials can alternatively be tested in accordance with ISO 15082.

6.1 Principle

Determination of whether the safety glazing material has a certain minimum strength and cohesion under impact from a small hard object.

6.2 Apparatus

6.2.1 Hardness steel ball, with a mass of 227 g ± 2 g and a diameter of approximately 38 mm.

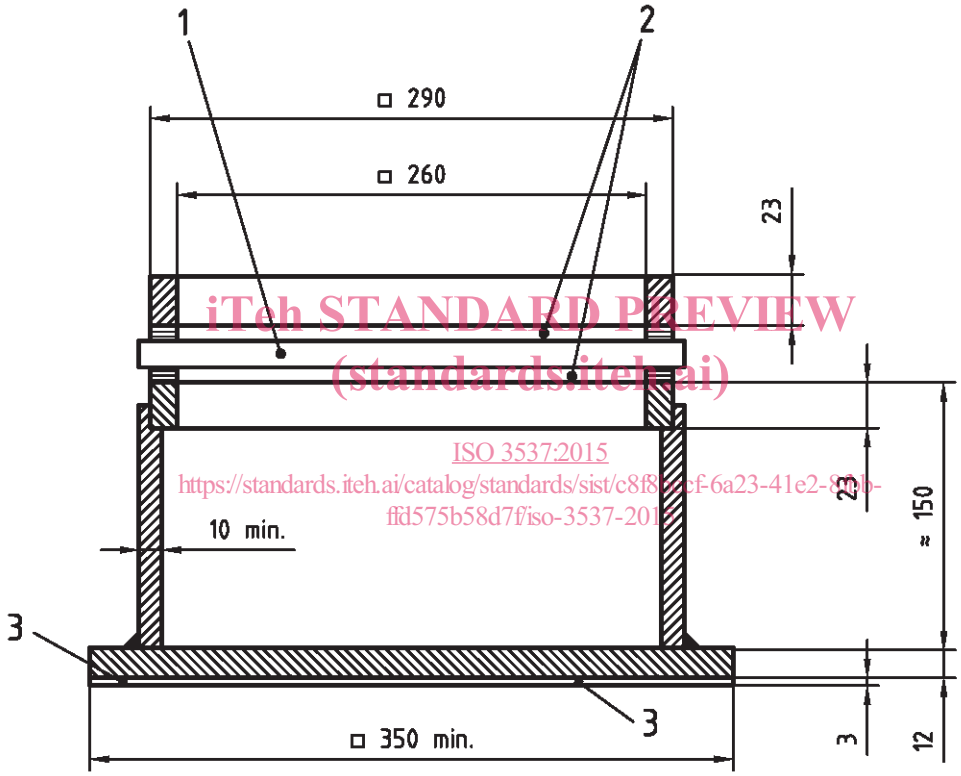
6.2.2 Means for dropping the ball freely from a height to be specified, or **means for giving the ball a velocity equivalent to that obtained by the free fall**.

When a device to project the ball is used, the tolerance on velocity shall be ±1 % of the velocity equivalent to that obtained by the free fall.

6.2.3 Supporting fixture, such as that shown in Figure 1, composed of two steel frames, with machined borders, 15 mm wide, fitting one over the other and faced with rubber gaskets about 3 mm thick and 15 mm wide, of hardness 50 IRHD, determined in accordance with ISO 48.

The lower frame rests on a steel box, about 150 mm high. The test piece is held in place by the upper frame, the mass of which is about 3 kg. The supporting frame is welded on a sheet of steel about 12 mm thick, resting on the floor, with an interposed sheet of rubber, about 3 mm thick, of hardness 50 IRHD.

Dimensions in millimetres



Key

1 test piece
2 rubber gasket
3 sheet of rubber

Figure 1 — Support for ball tests

6.3 Test piece

The test piece shall be a flat square with 300 mm $^{+10}_{0}$ mm sides or shall be cut out from the flattest part of a windscreen or other curved safety glazing material.

Alternatively, the whole windscreen or other finished safety glazing products can be tested, using the supporting fixture according to 6.2.3. In the case of curved test pieces, care shall be taken to ensure adequate contact between the safety glazing material and the support.

6.4 Procedure

Temperature of test pieces: Ambient temperature.

The 227 g ball test can alternatively be carried out on test pieces at −20 °C ± 2 °C or +40 °C ± 2 °C if specified.

Condition the test piece at the specified temperature for at least 4 h immediately preceding the test. If the specified test temperature is −20 °C or + 40 °C, the periods according to Table 1 between the removal of the test pieces from tempering and the release of the ball shall not be exceeded.

Table 1 — Period between the removal of the test piece from the temperature control unit and the release of the ball

Test piece thickness, *e* mm	Maximum interim period at test temperature −20 °C	Maximum interim period at test temperature + 40 °C
2,5 ≤ *e* ≤ 4,5	0 min 40 s	2 min 0 s
4,5 < *e* ≤ 6,5	1 min 0 s	2 min 0 s
6,5 < *e* ≤ 8,5	1 min 25 s	2 min 0 s
e > 8,5	1 min 40 s	2 min 0 s

If the test piece is less than 2,5 mm thick, then the test shall be carried out immediately at the given temperature.

Place the test piece in the fixture (6.2.3). The plane of the test piece shall be perpendicular, within 3°, to the incident direction of the ball. When necessary to retain the test piece in the fixture, it shall be clamped to ensure that the movement of the test piece during test shall not exceed 2 mm at any point along the inside periphery of the fixture.

The point of impact shall be within 25 mm of the geometric centre of the test piece for a drop height less than or equal to 6 m, and within 50 mm of the centre of the test piece for a drop height greater than 6 m.

The ball shall strike the face of the test piece which represents the outside face of the safety glazing material when mounted on the vehicle. The ball shall be allowed to make only one impact.

6.5 Expression of results

Assess the type and extent of damage to the test piece. If fragments are detached from the test piece, the total mass of the fragments and the mass of the largest fragment, detached from the side remote from impact, shall be weighed to the nearest 0,1 g. Report the drop height and temperature for each test piece and whether the test piece supported or did not support the 227 g ball.

7 2 260 g ball test

Rigid plastic safety glazing materials may alternatively be tested in accordance with ISO 15082.

7.1 Principle

Evaluation of the penetration resistance of the safety glazing material.

7.2 Apparatus

7.2.1 Hardened steel ball, with a mass of 2 260 g ± 20 g and a diameter of approximately 82 mm.

7.2.2 Means for dropping the ball freely from a height to be specified, or **means for giving the ball a velocity equivalent to that obtained by the free fall**.

When a device to project the ball is used, the tolerance on velocity shall be ±1 % of the velocity equivalent to that obtained by the free fall.

7.2.3 Supporting fixture, as described in 6.2.3.

7.3 Test piece

The test piece shall be a flat square with $300\,^{+10}_{0}$ mm sides or shall be cut out from the flattest part of a windscreen or other curved safety glazing material.

Alternatively, the whole windscreen or other finished safety glazing products can be tested, using the supporting fixture according to 6.2.3. In the case of curved test pieces, care shall be taken to ensure adequate contact between the safety glazing material and the support.

7.4 Procedure

Condition the test piece at the specified temperature for at least 4 h immediately preceding the test.

Place the test piece in the fixture (6.2.3). The plane of the test piece shall be perpendicular, within 3°, to the incident direction of the ball. When necessary to retain the test piece in the fixture, the test piece in the fixture shall be clamped to ensure that the movement of the test piece during test shall not exceed 2 mm at any point along the inside periphery of the fixture.

The point of impact shall be within 25 mm of the geometric centre of the test piece. The ball shall strike the face of the test piece which represents the internal face of the safety glazing material when mounted on the vehicle. The ball shall be allowed to make only one impact.

7.5 Expression of results

If the ball passes completely through the test piece within 5 s after the impact, the result shall be recorded as a “penetration”. If the ball remains on top of the test piece, or wedged in a hole, for 5 s or more, the result shall be recorded as a “support”. Report the drop height and temperature for each test piece.

8 Abrasion resistance test

Test rigid plastic safety glazing materials in accordance with ISO 15082.

8.1 Principle

Determination of whether the safety glazing material has a certain minimum resistance to abrasion at ambient temperature.

8.2 Apparatus

8.2.1 Abrading instrument[1)], shown diagrammatically in Figure 2, and consisting of the following:

1) A suitable abrading instrument is supplied by Taber Industries (USA). This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products can be used if they can be shown to lead to the same results.

— A horizontal turntable and centre clamp which revolves counter-clockwise at a fixed speed of 60 r/min ± 2 r/min or 72 r/min ± 2 r/min.

— Two weighted parallel arms, each carrying a special abrasive wheel freely rotating on a ball bearing horizontal spindle; each wheel rests on the test piece under the pressure exerted by a mass of 500 g, unless otherwise specified.

— A vacuum suction system (not depicted in Figure 2) and vacuum pick-up nozzle to remove debris and abrasive particles from the test piece surface during testing. The height of the vacuum pick-up nozzle shall be adjustable, and the nozzle openings shall have a diameter of 11 mm.

In the case of a nominal nozzle opening equal to 8 mm, the nozzle openings shall be enlarged to 11 mm following the instructions shown in Annex A, or by installation of a replacement nozzle with 11 mm openings.

The turntable of the abrading instrument shall rotate regularly, substantially in one plane (the deviation from this plane shall not be greater than ±0,05 mm at a distance of 1,6 mm from the turntable periphery).

The wheels shall be mounted in such a way that when they are in contact with the rotating test piece, they rotate in contrary directions so as to exert a compressive and abrasive action along curved lines over an annular area of about 30 cm^2, twice during each rotation of the test piece.

Verify calibration of the abrading instrument as directed by the equipment manufacturer. For one Taber abraser, see Annex B.

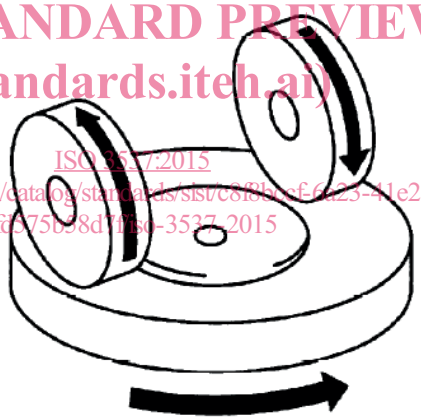


Figure 2 — Diagram of abrading instrument

8.2.2 Abrasive wheels[2] having a cylindrical shape and composed of a resilient binder and abrasive particles such as aluminium oxide and silicon carbide particles. The abrasive particles shall have a particle size between 20 microns and 102 microns and uniform distribution throughout the resilient binder. Each wheel shall be moulded to a hub which includes an axial hole 16,0 mm ± 0,1 mm, allowing the wheels to be mounted to the flange holder on the abraser arms. The sides of the wheel shall be parallel, and each wheel shall be 12,7 mm ± 0,3 mm wide and have an external diameter of less than 52,5 mm and in no case less than 44,4 mm. If a different wheel has been used, which has been documented to produce equivalent results, the description of the wheel shall be included with the results.

The abrasive wheel shall be such that the light scatter resulting from abrading [final haze minus initial haze (8.6)] of each of three float glass samples subjected to 1 000 cycles of abrasion is within 0,7 % ± 0,5 %.

2) Such as Calibrase CS-10F wheels available from Taber Industries (USA) or C180 OXF wheels available from DAIWA Kasei Kogyo (Japan). This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the products named. Equivalent products can be used if they can be shown to lead to the same results.

The float glass shall be 3 to 4 mm in thickness and of at least 70 % luminance transmittance. Abrasion should be conducted on the upper glass side (air or fire side).

8.2.3 Refacing stone. The fine side of a Taber ST-11 refacing stone (or equivalent) shall be used for resurfacing the abrasive wheels. It is important that the turntable platform runs true on the abraser and that the refacing stone lies flat on the turntable platform.

8.2.4 Hazemeter[3], shown diagrammatically in Figure 3 and consisting of the following:

— A light source and a photodetector, and the combination shall be filtered to provide an output corresponding to the luminosity response of the 1931 CIE Standard Colourimetric Observer with CIE Standard Illuminant C or, alternatively, Illuminant A. The output shall be proportional to within 1 % to the incident flux over the range of flux used. The photometric stability for source and detector shall be constant throughout the test of each test piece (specimen).

— An integrating sphere to collect transmitted flux; the sphere can be of any diameter as long as the total port areas do not exceed 4,0 % of the internal reflecting area of the sphere. The entrance and exit ports shall be centred on the same great circle of the sphere, and there shall be at least 2,97 rad (170°) of arc between centres. The exit port shall subtend an angle of 0,14 rad (8°) at the centre of the entrance port. With the light trap in position, without the test piece, the axis of the irradiating beam shall pass through the centres of the entrance and exit ports. For a hazemeter, position the photocell or photocells on the sphere 1,57 rad ± 0,17 rad (90° ± 10°) from the entrance port and baffle it from direct exposure to the entrance port. In the pivotable modification where the interior wall adjacent to the exit port is used as the reflectance reference, the angle of rotation of the sphere shall be 0,140 rad ± 0,008 rad (8,0° ± 0,5°).

Illuminate the test piece by a substantially unidirectional beam; the maximum angle that any ray of this beam can make with the beam axis shall not exceed 0,05 rad (3°). This beam shall not be vignette at either port of the sphere.

When the test piece is placed against the entrance port of the integrating sphere, the angle between the perpendicular to the test piece and a line connecting the centres of entrance and exit ports shall not exceed 0,14 rad (8°).

An aperture or diaphragm shall be centrally inserted in the haze measuring apparatus to centre the light beam on the abradant track and limit it to a diameter of 7 mm ± 1 mm at the test piece.

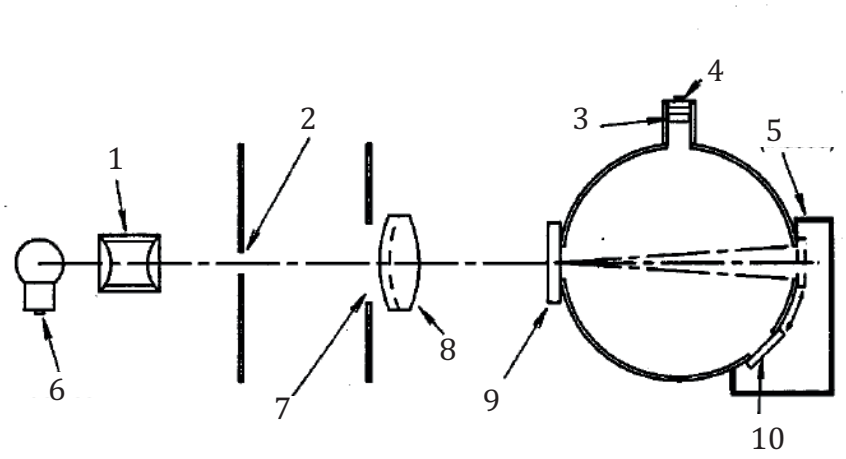
When the reduced light is unobstructed by a test piece, its cross section at the exit port shall be approximately circular, sharply defined, uniformly bright, and concentric within the exit port, leaving an annulus of 0,023 rad ± 0,002 rad (1,3° ± 0,1°) subtended at the entrance port.

The surfaces of the interior of the integrating sphere, baffles, and reflectance standard, if used, shall be of equal reflectance, matte, and highly reflecting throughout the visible spectrum.

A light trap shall be provided that will absorb the beam completely when no test piece is present, or the instrument design shall obviate the need for a light trap.

Forward scattering glass standards can be used to check that the optical system of the hazemeter is properly adjusted.

3) A suitable instrument for measuring haze is supplied by BYK-Gardner (USA). This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products can be used if they can be shown to lead to the same results.



Key

1	condenser	6	source
2	entrance window	7	aperture
3	filter	8	lens
4	photo detector	9	specimen
5	light trap (if used)	10	reflectance standard

NOTE Dotted lines show position of reflectance standard for total transmittance measurement.

Figure 3 — Hazemeter

8.2.5 Test piece holder. A suitable holder shall be used to permit positioning the abraded test piece on the hazemeter so that the light beam is centred in the abraded track and the test piece is flush at the measurement port.

Calibrate the hazemeter with the test piece holder before the initial measurement of the haze with no test piece present and verify that the reading of the hazemeter is zero.

The whole apparatus shall be checked at regular intervals by means of calibration standards of defined haze.

If haze measurements are made using equipment or methods differing from the above, the results shall be corrected in order to be in agreement with those obtained by the apparatus described above.

8.3 Test pieces

The test pieces shall be flat squares with 100 mm sides having both surfaces substantially plane and parallel, and optionally with a 6,3 mm diameter fixing hole drilled in the centre.

8.4 Standardization of abrading wheels

To ensure that the abrading function of the wheels is maintained at a constant level, prepare the abrading wheels prior to each test. Mount the wheels on their respective flange holders, taking care not to handle them by their abrasive surfaces. Select the load to be used and affix it to the abraser. If no load is specified, use a load of 500 g (per wheel). Mount a Taber ST-11 refacing stone (or equivalent) on the turntable, fine side up, and secure using the nut.