INTERNATIONAL STANDARD

ISO 15082

First edition
1999-07-15

Road vehicles — Tests for rigid plastic safety glazing materials

Véhicules routiers — Essais pour les vitrages de sécurité rigides en matières plastiques

Reference number
ISO 15082:1999(E)

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 15082 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 11, *Safety glazing materials*.

Annex A of this International Standard is for information only.

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Printed in Switzerland

Road vehicles — Tests for rigid plastic safety glazing materials

1 Scope

This International Standard specifies all test methods relating to the safety requirements for rigid plastic safety glazing materials in a road vehicle, regardless of the type of plastic of which they are composed.

NOTE Plastic safety glazing materials are classified as rigid or flexible by use of the test described in annex A.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 3536:1999, *Road vehicles — Safety glazing materials — Vocabulary.*

ISO 3538:1997, *Road vehicles — Safety glazing materials — Test methods for optical properties.*

ISO 3917:1999, *Road vehicles — Safety glazing materials — Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering.*

ISO 4892-2:1994, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources.*

IEC 60695-11-10:1999, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods.*[1)]

3 Terms and definitions

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

1) Revision of ISO 1210:1992

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 Conditioning of test specimens

Unless otherwise specified, all test specimens to be tested shall be conditioned prior to testing under the following conditions and for the following periods of time:

— ambient temperature: 23 °C ± 2 °C for at least 48 h;

— ambient relative humidity: (50 ± 5) % for at least 48 h;

— low temperature: –18 °C ± 2 °C for at least 24 h.

6 Application of tests

It is not necessary to carry out all the tests specified in this International Standard when the results, according to the purpose of testing, can be predicted with certainty from knowledge of the properties of the plastic safety glazing material concerned.

7 Optical properties test

Test plastic safety glazing materials in accordance with ISO 3538.

8 Head-form/fragmentation test

8.1 Principle

Determine the fragmentation characteristics of plastic safety glazing materials at ambient temperature.

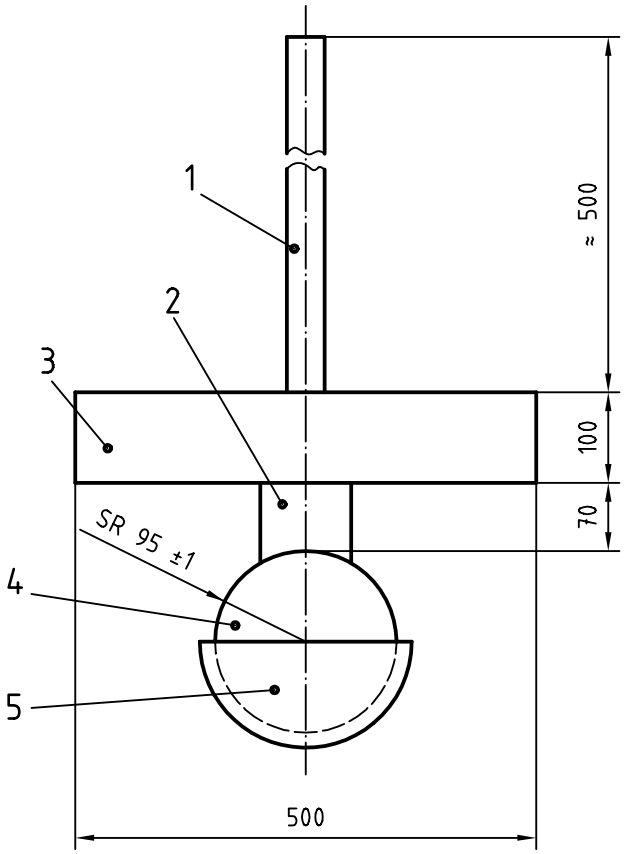
8.2 Apparatus

8.2.1 Head-form weight, with a spherical or semi-spherical head made of laminated hardwood covered with replaceable felt and with or without a cross- beam made of wood. Between the spherical part and the cross-beam, there is a neck shaped intermediate piece and on the other side of the cross-beam, a mounting rod.

The dimensions shall be in accordance with Figure 1.

The total mass of the apparatus shall be 10 kg ± 0,2 kg.

Dimensions in millimetres



Key

1 Mounting rod
2 Intermediate piece
3 Cross-beam (optional)
4 Head
5 Felt cover 5 mm thick

Figure 1 — Head-form weight

8.2.2 Means for dropping the head-form weight freely from a height to be specified, or means for giving the weight a velocity equivalent to that obtained by the free fall.

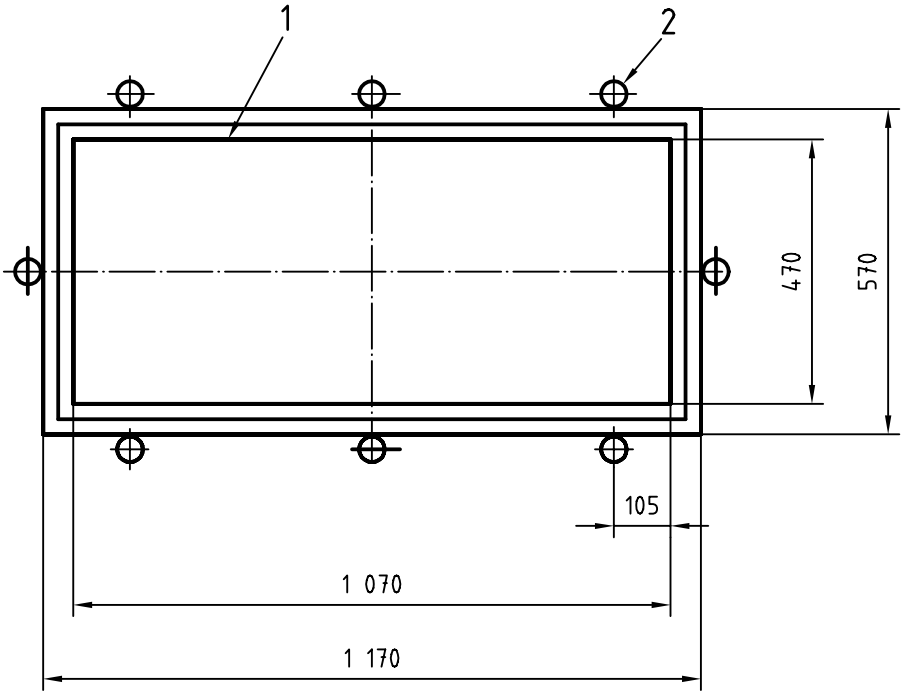
When a device to project the head-form weight is used, the tolerance on velocity shall be ± 1 % of the velocity equivalent to that obtained by the free fall.

8.2.3 Supporting fixture, as shown in Figure 2, for testing flat test specimens. The fixture is composed of two steel frames, with 50 mm wide machined edges, fitting one over the other and faced with rubber gaskets about 3 mm thick, and 15 mm ± 1 mm wide, of hardness 70 IRHD, measured in accordance with ISO 48. The upper frame is pressed against the lower frame by at least eight bolts; the minimum recommended torque for M20 bolts is 30 nm.

8.3 Test specimens

Test specimens shall be flat rectangles with length 1 100 mm $^{+5}_{-2}$ mm and width 500 mm $^{+5}_{-2}$ mm.

Dimensions in millimetres



Key

1 Rubber gasket
2 Bolt

Figure 2 — Support for head-form tests

8.4 Procedure

Place a conditioned test specimen in the supporting fixture (Figure 2); the torque on the bolts shall ensure that the movement of the test specimen during the test will not exceed 2 mm. The plane of the test specimen shall be substantially perpendicular to the incident direction of the head-form weight.

The head-form weight shall strike the test specimen, from a height to be specified, within 40 mm of its centre on that face which represents the inside face of the plastic safety glazing material when mounted on the vehicle, and shall be allowed to make only one impact.

The felt cover shall be replaced after 12 tests.

8.5 Expression of results

Evaluate the fracture characteristics of the plastic safety glazing material by recording whether the test specimen did not break and the head-form was supported, or the test specimen broke and the head-form was supported, or the test specimen broke and the head-form was not supported. Record the drop height for each impact test.

In the event of fracture, evaluate the plastic safety glazing material by recording the smallest angle between two adjacent sides of resulting fragments and the area, longest dimension, and weight of the largest fragment. Record this data for the fragments remaining in the supporting fixture and for those that are dislodged from the supporting fixture.

9 Impact tests

9.1 227 g ball test

9.1.1 Principle

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

9.1.2 Apparatus

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

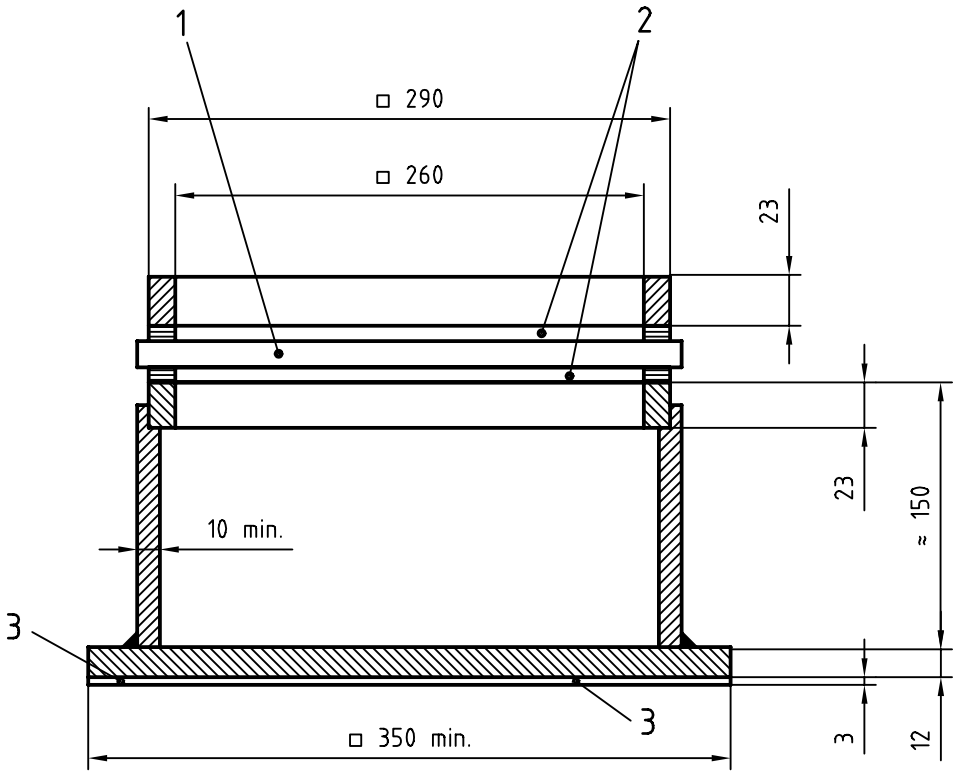
9.1.2.2 Means for dropping the ball freely from a height to be specified, or means for giving the ball a velocity equivalent to that obtained by the free fall.

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.

9.1.2.3 Supporting fixture, such as that shown in Figure 3, composed of two steel frames with 15 mm wide machined borders, 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 specimen 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 3 — Support for ball tests

9.1.3 Test specimens

Test specimens shall be flat squares with 300 mm $^{+10}_{0}$ mm sides.

9.1.4 Procedure

Place a conditioned test specimen in the supporting fixture and conduct the impact test at once. To minimize the temperature change of the test specimen, the test should take place as quickly as possible (within 30 s of its removal from the conditioning appliance). The plane of the test specimen shall be perpendicular, within 3°, to the incident direction of the ball. When necessary to retain the test specimen in the fixture, it shall be clamped to ensure that the movement of the test specimen during the test will 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 specimen for a drop height less than or equal to 6 m, and within 50 mm of the geometric centre of the test specimen for a drop height greater than 6 m.

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

9.1.5 Expression of results

Evaluate the strength, type, and extent of damage to the test specimen. Record the drop height, and temperature for each test specimen and whether the test specimen supported or did not support the 227 g ball.

9.2 2 260 g ball test

9.2.1 Principle

Determination of whether the plastic safety glazing material has a certain minimum penetration resistance under impact from a large hard object at ambient and low temperature.

9.2.2 Apparatus

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

9.2.2.2 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.

9.2.2.3 Supporting fixture, such as that shown in Figure 3 and specified in 9.1.2.3.

9.2.3 Test specimens

Test specimens shall be flat squares with 300 mm $^{+10}_{0}$ mm sides or shall be cut out from the flattest part of a plastic safety glazing material.

9.2.4 Procedure

Place a conditioned test specimen in the supporting fixture and conduct the impact test at once. To minimize the temperature change of test specimens conditioned at low temperature, the test should take place as quickly as possible (within 30 s of its removal from the conditioning appliance). The plane of the test specimen shall be perpendicular, within 3°, to the incident direction of the ball. When necessary to retain the test specimen in the fixture, it shall be clamped to ensure that the movement of the test specimen during test will not exceed 2 mm at any point along the inside periphery of the fixture.

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

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

9.2.5 Expression of results

Evaluate the ability of the plastic safety glazing material to support the impacting ball for each velocity and temperature. If the ball passes completely through a test specimen within 5 s after impact, the result shall be recorded as a "non-support". If the ball remains on top of a test specimen or wedged in a hole, for 5 s or more, the result shall be recorded as a "support". Record the drop height.

10 Abrasion resistance test

10.1 Principle

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

10.2 Apparatus

10.2.1 Abrading instrument[2)] , shown diagrammatically in Figure 4 and consisting of a horizontal turntable and centre clamp which revolves counter-clockwise at 55 r/min to 75 r/min and two weighted parallel arms, each carrying a special abrasive wheel freely rotating on a ball bearing horizontal spindle. Each wheel rests on the test specimen under the pressure exerted by a mass of 500 g.

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 specimen, 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 specimen.

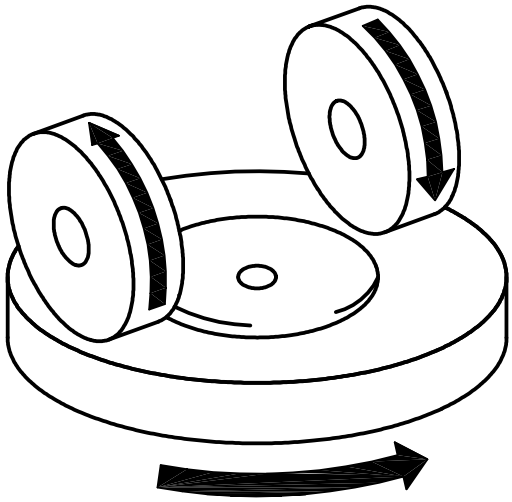


Figure 4 — Diagram of abrading instrument

2) 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 may be used if they can be shown to lead to the same results.

10.2.2 Abrasive wheels[3)] , each 45 mm to 50 mm in diameter and 12,5 mm thick, composed of special finely screened abrasive embedded in a medium-hard rubber. The wheels shall have a hardness of 72 IRHD ± 5 IRHD measured at four points equally spaced on the centreline of the abrading surface with the pressure directly applied vertically along a diameter of the wheel, the readings being taken 10 s after full application of pressure.

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

New wheels shall be broken in by 100 revolutions on the ST-11 refacing stone or disk with a load of 500 g on each wheel, followed by 500 revolutions on the material to be tested, followed by 25 revolutions on the ST-11 refacing stone or disk prior to starting the test on the test specimen.

Reface previously used wheels for 25 cycles before abrading each test specimen. In each case, brush the residue from the stone during the process. **Caution — Do not touch the surface of the wheels after they are refaced.**

Discard the ST-11 refacing stone when grooves or ridges first become evident. Abrasive wheels shall not be used after the date stamped on them.

10.2.3 Light source, consisting of an incandescent lamp, the filament of which is contained within a parallelepiped 1,5 mm × 1,5 mm × 3 mm. The voltage at the lamp terminals shall be such that the colour temperature is 2 856 K ± 50 K. This voltage shall be stabilized within 1/1 000. The instrument used to check the voltage shall be of appropriate accuracy for this application. Alternatively, the source colour, Illuminant A, may be altered to Illuminant C by placing a daylight filter in the light beam.

10.2.4 Optical system, consisting of a lens corrected for chromatic aberrations. The clear aperture of the lens shall not exceed $f/20$. The distance between the lens and the light source shall be adjusted in order to obtain a light beam which is substantially parallel.

A diaphragm shall be inserted to limit the diameter of the light beam to 7 mm ± 1 mm. This diaphragm shall be situated at a distance of 100 mm ± 50 mm from the lens on the side remote from the light source.

10.2.5 Equipment for measuring scattered light (see Figure 5), consisting of a photoelectric cell with an integrating sphere of diameter 200 mm to 250 mm. The sphere shall be equipped with entrance and exit ports for the light. The entrance port shall be circular and have a diameter at least twice that of the light beam. The exit port of the sphere is provided with a light-trap or a reflectance standard respectively according to the procedure specified in 10.4.3. The light-trap shall absorb the light when no test specimen is inserted in the light beam.

The axis of the light beam shall pass through the centre of the entrance and exit ports. The diameter b of the light exit port shall be equal to $2a \tan 4°$, where a is the diameter of the sphere.

The photoelectric cell shall be mounted in such a way that it cannot be reached by light coming directly from the entrance port or from the reflectance standard.

The surfaces of the interior of the integrating sphere and the reflectance standard shall be of substantially equal reflectance and shall be matte and non-selective.

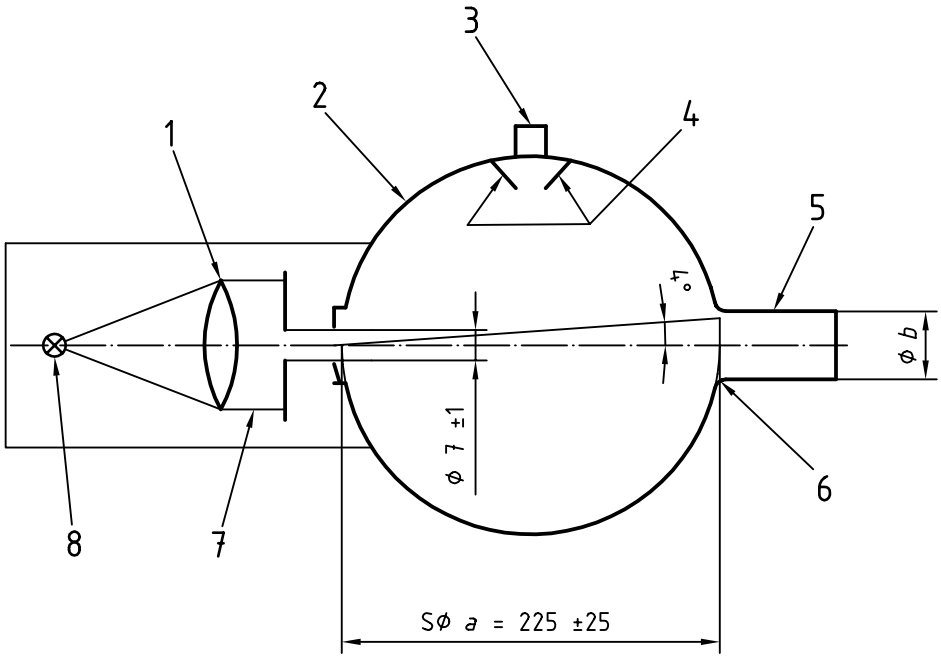
The output of the photoelectric cell shall be linear within ± 2 % over the range of luminous intensity used. The design of the instrument shall be such that there is no galvanometer deflection when the sphere is dark.

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.

[3)] Such as calibrase CS-10F wheels available from 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 may be used if they can be shown to lead to the same results.

Dimensions in millimetres



Key

1	Lens	5	Baffles
2	Integrating sphere	6	Opening of light-trap
3	Photoelectric cell	7	Parallel beam
4	Light-trap	8	Lamp

Figure 5 — Hazemeter (Illuminant A)

10.3 Test specimens

Test specimens 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.

10.4 Procedure

The abrasion test shall be carried out on both inside and outside surfaces of the plastic safety glazing material. The inside surface specimens shall be subjected to 100 revolutions of the abrading instrument and the outside surface specimens shall be subjected to 500 revolutions.

10.4.1 Immediately before and after the abrasion, clean the test specimen in the following manner:

a) wipe with a linen cloth under clean running water;

b) rinse with distilled or demineralized water;

c) blow dry with ionized air or nitrogen;

d) remove possible traces of water by dabbing softly with a damp linen cloth. If necessary, dry by pressing lightly between two linen cloths.

Any treatment with ultra-sonic equipment shall be avoided.

After cleaning, the test specimens shall be handled only by their edges and shall be stored to prevent damage to, or contamination of, their surfaces.

10.4.2 Condition the abrasive wheels, prior to testing, for a minimum of 48 h at the same conditions of temperature and relative humidity as the test specimens to be tested.

10.4.3 Immediately place a test specimen against the entrance port of the integrating sphere. The angle between the normal to the surface of the test specimen and the axis of the beam shall not exceed 8°.

Take the four readings indicated in Table 1.

Table 1

Reading	With test specimen	With light-trap	With reflectance standard	Quantity represented
τ_1	No	No	Yes	Incident light
τ_2	Yes	No	Yes	Total light transmitted by test specimen
τ_3	No	Yes	No	Light scattered by instrument
τ_4	Yes	Yes	No	Light scattered by instrument and test specimen

Repeat readings for τ_1, τ_2, τ_3 and τ_4 with additional specified positions of the test specimen to determine uniformity.

Calculate the total transmittance:

$$\tau_t = \tau_2/\tau_1 \quad (1)$$

Calculate the diffuse transmission τ_d as follows:

$$\tau_d = \frac{\tau_4 - \tau_3(\tau_2/\tau_1)}{\tau_1 - \tau_3} \quad (2)$$

Calculate the percentage haze, or light, or both, scattered as follows:

$$\frac{\tau_d}{\tau_t} \times 100 \quad (3)$$

Calculate the initial haze of the test specimen at a minimum of four equally spaced points in the unabraded area in accordance with formula (3). Average the results for each test specimen. In lieu of the four measurements, an average value may be obtained by rotating the test specimen uniformly at 3 r/s or more.

For each plastic safety glazing material, carry out three tests with the same load. Abrade the outside surface for 500 cycles. With three new test specimens, abrade the inside surface for 100 cycles.

The abrasion test shall be carried out under the same conditions as those which were used to condition the test specimens and abrasive wheels prior to the abrasion test.

Calculate the light scattered by the abraded track at a minimum of four equally spaced points along the track in accordance with formula (3). Average the results for each test specimen. In lieu of the four measurements, an average value may be obtained by rotating the test specimen uniformly at 3 r/s or more.

10.5 Expression of results

Subtract the average initial haze from the average total light scattered, the difference representing the light scatter resulting from abrading the test specimen; this subtraction will be done for test specimens abraded for 100 and for 500 cycles.

Report this difference for 100 cycles (inside surface) and 500 cycles (outside surface). The report shall indicate whether Illuminant A or Illuminant C has been employed.

11 Chemical resistance test

11.1 Principle

This test method evaluates the resistance of plastic safety glazing materials to various solvents and cleaners at ambient temperature.

11.2 Chemical agents to be used

11.2.1 1 % solution by weight of a non-abrasive soap in deionized water (i.e. potassium oleate or equivalent).

11.2.2 Gasoline or equivalent reference fuel composition, i.e. ASTM Reference Fuel C.

NOTE ASTM Reference Fuel C is composed of Isooctane 50 volume percentage and Toluene 50 volume percentage. Isooctane must conform to A 2.7 in Annex 2 of the Motor Fuels Section of the 1985 Annual Book of ASTM Standards Vol. 05.04 and Toluene must conform to ASTM specification D362-84, Standard Specification for Industrial Grade Toluene.

11.2.3 Kerosene, No. K-1 or K-2 (as defined by ASTM D3699-92 Standard Definitions for Kerosene, JIS K-2203) or equivalent.

11.2.4 Denatured alcohol, one part 100 % methyl alcohol to 10 parts 95 % ethyl alcohol by volume.

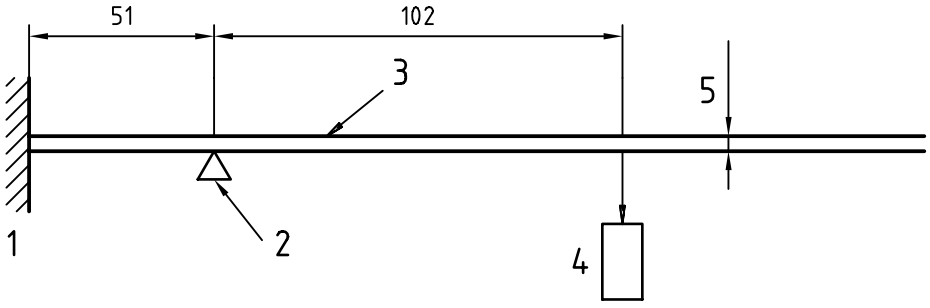
11.3 Test specimens

Test specimens shall be flat, 25 mm wide × 180 mm long.

11.4 Test procedure

11.4.1 The test specimen shall be simply supported as a horizontal lever arm between a fixed supporting edge at one end in such a way that the entire width will rest on a cutting edge (fulcrum) which is 51 mm from the fixed end support. A load shall be suspended from the free end of the test specimen at a distance of 102 mm from the fulcrum as shown in Figure 6.

Dimensions in millimetres



Key

1 Fixed end
2 Fulcrum point
3 Specimen
4 Load
5 Plate thickness

Figure 6 — Method of setting up the test specimen

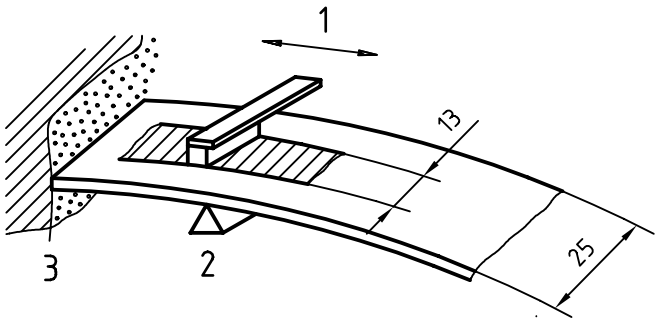
11.4.2 The load mass shall be 28,7 t^2 g where t is the thickness in millimetres of the test specimen. The resulting stress on the outer fibre of the test specimen is approximately 6,9 MPa.

EXAMPLE

For a 3 mm thick test specimen placed horizontally between a downward fixed edge and an upward fulcrum edge separated by 51 mm, the applied downward load at 102 mm from the fulcrum is to be 258 g.

11.4.3 While the test specimen is stressed, one of the prescribed chemicals shall be applied to the top surface of the test specimen above the fulcrum point. The chemical shall be applied with a soft, 13 mm wide brush, wetted before each stroke. Ten individual strokes at 1 s intervals across the width of the test specimen, avoiding the end and edges, shall be required. See Figure 7.

Dimensions in millimetres



Key

1 Direction of application
2 Fulcrum point
3 Fixed end

Figure 7 — Method of applying chemicals to the test specimen

11.4.4 One minute after the last stroke the test specimen shall be wiped dry with clean absorbent cotton and immediately examined visually for any change in physical appearance while in the stressed state.

11.5 Expression of results

Identify each of the chemical agents used by recording the actual composition or standard reference material. Examine each of the test specimens tested and note any evidence of surface defects, tackiness, crazing, cracks or loss of transparency. For each of the chemical agents used, record the number of test specimens tested.

12 Resistance to simulated weathering test

12.1 Principle

Determination of whether plastic safety glazing materials will successfully withstand exposure to simulated weathering conditions.

12.2 Exposure apparatus

12.2.1 Two types of light sources can be used, the long arc xenon and open flame carbon arc lamps. Either light source may be used for this test. Because of spectral differences between the xenon arc and open flame carbon arc, however, test results from the two light sources may or may not correlate, depending on the materials under test.

12.2.2 Long arc xenon lamp[4] **,** in accordance with ISO 4892-2:1994, clause 4.

The long arc xenon lamp, when correctly filtered and maintained, yields a spectrum closely approximating that of natural sunlight. To this end, the quartz xenon burner tube shall be fitted with suitable borosilicate glass optical filter(s)[5] . The xenon lamps employed shall be operated, from a suitable 50 Hz or 60 Hz power supply, through suitable reactance transformers and electrical equipment.

The UV radiation distribution shall be as specified in ISO 4892-2:1994, Table 1. Relative spectral irradiance for artificial weathering (Method A).

The exposure apparatus shall include equipment necessary for measuring and/or controlling the following:

a) irradiance;

b) black standard temperature;

c) water spray;

d) operating schedule or cycle.

The exposure apparatus shall be made from inert materials, which do not contaminate the water employed in the test.

Irradiance shall be measured at the test specimen surface and shall be controlled according to the recommendation of the exposure apparatus manufacturer.

Total ultraviolet radiant exposure, in joules per square metre, shall be measured or computed and shall be considered the primary measure of test specimen exposure.

NOTE Total ultraviolet is considered to be all radiation of wavelength less than 400 nm.

12.2.3 In case of using the **open flame carbon arc lamp light source**, test plastic safety glazing materials using only the exposure apparatus and procedure contained in ISO 3917.

12.3 Test specimens

The dimensions of the test specimens shall normally be those specified in the appropriate test method for the property or properties to be measured after exposure.

The number of control and test specimens for each test condition or exposure stage shall be determined, in addition to those required for visual evaluations specified in 12.5.2, by the number required by the test methods.

It is recommended that visual evaluations be conducted on the largest test specimens tested.

12.4 Procedure

12.4.1 Measure in accordance with the ISO 3538, the luminous transmission of the test specimens to be exposed. Measure, in accordance with the abrasion resistance test specified in clause 10, the resistance to abrasion of both faces of the control specimens.

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[4] Such as Atlas Ci or Xenotest Series or Suga WEL-X Series. These are tradenames. 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 may be used if they can be shown to lead to the same results.

[5] Borosilicate glass filiters such as Corning 7746 Pyrex, Atlas Type S, and Atlas Suprax have been found satisfactory. These are tradenames. 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 may be used if they can be shown to lead to the same results.

That face of each test specimen which would represent the surface mounted to the outside of the vehicle shall face the lamp.

NOTE It is not necessary to condition test specimens prior to exposure in this test as the test itself includes special conditions.

Other exposure conditions shall be as follows:

12.4.2 In accordance with ISO 4892-2, the irradiance shall not vary more than + 10 % over the whole test specimen area.

12.4.3 At appropriate intervals, clean lamp filters by washing with detergent and water. Xenon arc filters shall be replaced according to the recommendations of the equipment manufacturer.

12.4.4 The temperature within the exposure apparatus during the dry portion of the cycle shall be controlled by circulation of sufficient air to maintain a constant black standard temperature.

This temperature shall be 70 °C ± 3 °C (as indicated by a Black Standard Thermometer[6)] or equivalent). The thermometer is preferably mounted on a support for a test panel in such a way that it receives the same radiation and cooling conditions as a flat test panel surface on the same support. It may also be located at a fixed distance position different from the test specimen distance and calibrated for temperature at the test specimen distance.

12.4.5 The relative humidity within the exposure apparatus shall be controlled at (50 ± 5) % during the dry portions of the cycle.

12.4.6 The deionized water used in the spray cycle shall contain less than 1 µg/ml silicon dioxide solids and shall leave no permanent deposit or residue on the test specimens which would interfere with subsequent measurements.

12.4.7 The pH of the water shall be between 6,0 and 8,0, and the conductivity shall be less than 5 µS.

12.4.8 The temperature of the water in the line where it enters the exposure apparatus shall be the ambient water temperature.

12.4.9 The water shall strike the test specimens in the form of a fine spray in sufficient volume to wet the test specimens uniformly, immediately upon impact.

Water spray will be directed only against the test specimen surfaces facing the light source. No recirculation of the spray water or immersion of the test specimens in the water shall be permitted.

12.4.10 The test specimens shall be rotated about the arc in order to provide uniform distribution of the light. All positions in the exposure apparatus shall be filled with test specimens or surrogates to ensure that a uniform temperature distribution is maintained. Test specimens shall be held in frames with backs exposed to the cabinet environment. However, reflections from cabinet walls shall not be permitted to strike the back surface of test specimens. If necessary, test specimens may be backed to block such reflections; the backing must not be in direct contact with the test specimen and must not impede the free circulation of air at the test specimen surface.

12.4.11 The exposure apparatus shall be operated to provide continuous light and intermittent water spray in 2 h cycles. Each 2 h cycle, in accordance with ISO 4892-2, shall be divided into periods during which the test specimens are exposed to light without water spray for 102 min and to light with water spray for 18 min.

12.5 Evaluation

12.5.1 After exposure, the test specimens may be cleaned, if necessary, by a practice recommended by their manufacturer to remove any residues present.

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6) The Black Standard Thermometer (BST) is defined in ISO 4892-1.

12.5.2 Evaluate the exposed test specimens visually with respect to the following properties:

a) bubbles;

b) colour[7)] ;

c) haze;

d) noticeable decomposition.

12.5.3 Measure on separate test specimens, in accordance with the abrasion resistance test, specified in clause 10 and ISO 3538 respectively, the resistance to abrasion and luminous transmission of the exposed test specimens on both sides.

12.6 Expression of results

Report visual evaluations of exposed test specimens, comparing the appearance of each with that of the unexposed control specimens. If colour is measured instrumentally, compute the colour change.

Report the changes in luminous transmittance and the changes in resistance to abrasion, comparing results of tests on unexposed control specimens. Note whether the side tested was facing toward or away from the lamp.

12.7 Report of test parameters

Report the following:

a) apparatus manufacturer;

b) exposure time, in hours;

c) total ultraviolet radiant exposure, in joules per square metre.

13 Flammability test

13.1 Principle

The purpose of this test is to determine the rate of burning of plastic safety glazing materials under ambient conditions.

13.2 Test specimens

At least three 150 mm × 13 mm flat test specimens shall be tested. The test specimens shall be marked by inscribing two lines, 25 mm and 100 mm from one end of each test specimen.

13.3 Test procedure

See IEC 60695-11-10. The test shall be conducted in a laboratory hood or draft-free enclosure greater than 0,5m^3 in size and provided with a means for venting the fumes from burning test specimens. If a hood is used its exhaust fan will be turned off during the test but allowed to run periodically to clear out the fumes between tests. The test specimen shall be clamped in a support, at the end farthest from the 25 mm mark, with its longitudinal axis horizontal and its transverse axis inclined at 45° to the horizontal. Under the test specimen there shall be clamped a 20 mesh per 25,4 mm Bunsen burner gauze about 125 mm square, in a horizontal position 6 mm below the edge of the test specimen, and with about 13 mm of the test specimen extending beyond the edge of the gauze as illustrated in Figure 8.

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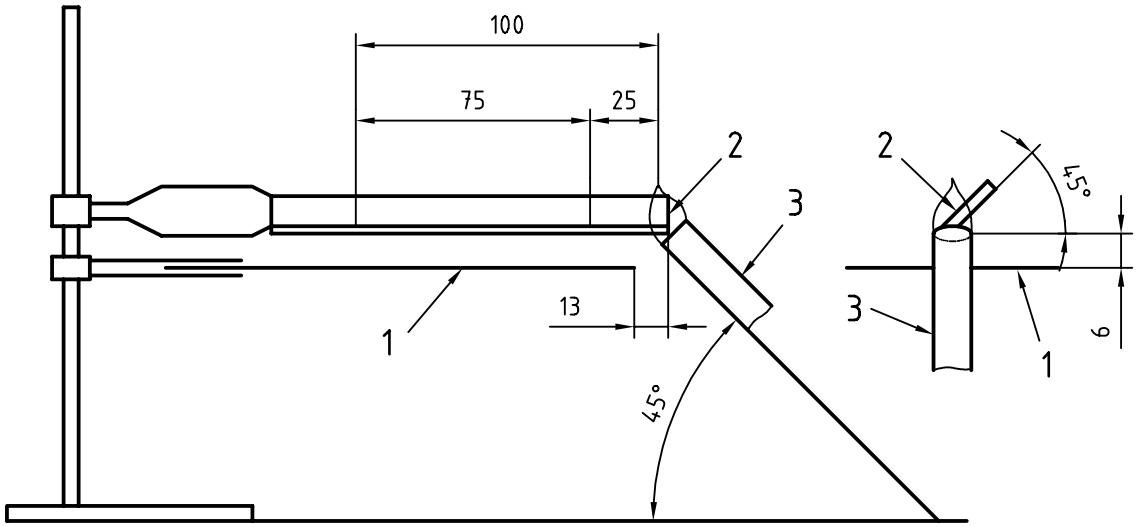
7) Colour change may be evaluated optionally by a method given in CIE 15.2.

A Bunsen burner with a blue, gas flame 12 mm to 20 mm in height shall be placed under the free end of the test specimen and adjusted so that the flame tip is just in contact with the test specimen. At the end of 30 s the flame shall be removed and the test specimen allowed to burn. A stop watch shall be started when the flame reaches the first mark, 25 mm from the end, and the time observed when the flame reaches the 100 mm mark. In case the test specimen does not continue to burn after the first ignition, the burner shall be placed under the free end for a second period of 30 s immediately following extinction of the flame.

Dimensions in millimetres



Key

1 Wire gauze
2 Test specimen
3 Burner
4 Wire gauze

Figure 8 — Horizontal burning test

13.4 Expression of results

The horizontal burning rate of each test specimen shall be recorded in millimetres per minute and the average reported. If a test specimen does not continue burning to the 100 mm mark after the second ignition, it shall be designated as non-sustaining in the test report.

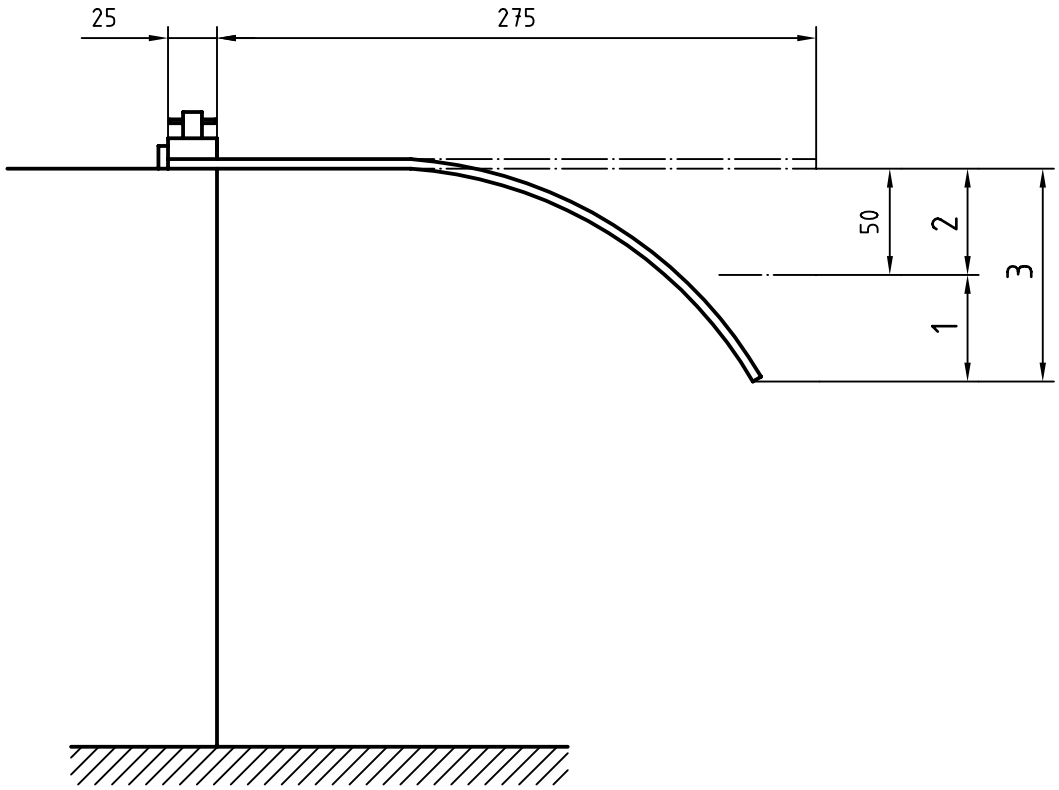
Annex A
(informative)

Flexibility/rigidity categorization test for plastic safety glazing material

A.1 General

Condition a 300 mm × 25 mm test specimen of the material to be categorized in accordance with clause 5. Horizontally clamp the test specimen at one end, and allow it to bend freely under its own weight (see Figure A.1) at the test conditions in accordance with clause 4.

Dimensions in millimetres



Key

1 Flexible
2 Rigid
3 Displacement

Figure A.1 — Arrangement of flexibility/rigidity test

If the deflection from horizontal is less than or equal to 50 mm after 60 s, the material shall be categorized as rigid. If the maximum deflection is greater than 50 mm, the material shall be categorized as flexible.

Bibliography

[1] ISO 3537:1999, *Road vehicles — Safety glazing materials — Mechanical tests.*

[2] ISO 4892-1:1999, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance.*

[3] CIE 15.2:1986, *Colorimetry.*

ICS 43.040.60; 83.140.01

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