BS ISO 3537:2015

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Road vehicles — Safety glazing materials — Mechanical tests

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National foreword

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Road vehicles — Safety glazing materials — Mechanical tests

Véhicules routiers — Vitrages de sécurité — Essais mécaniques

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Contents

Page

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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.

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INTERNATIONAL STANDARD ISO 3537:2015(E)

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.

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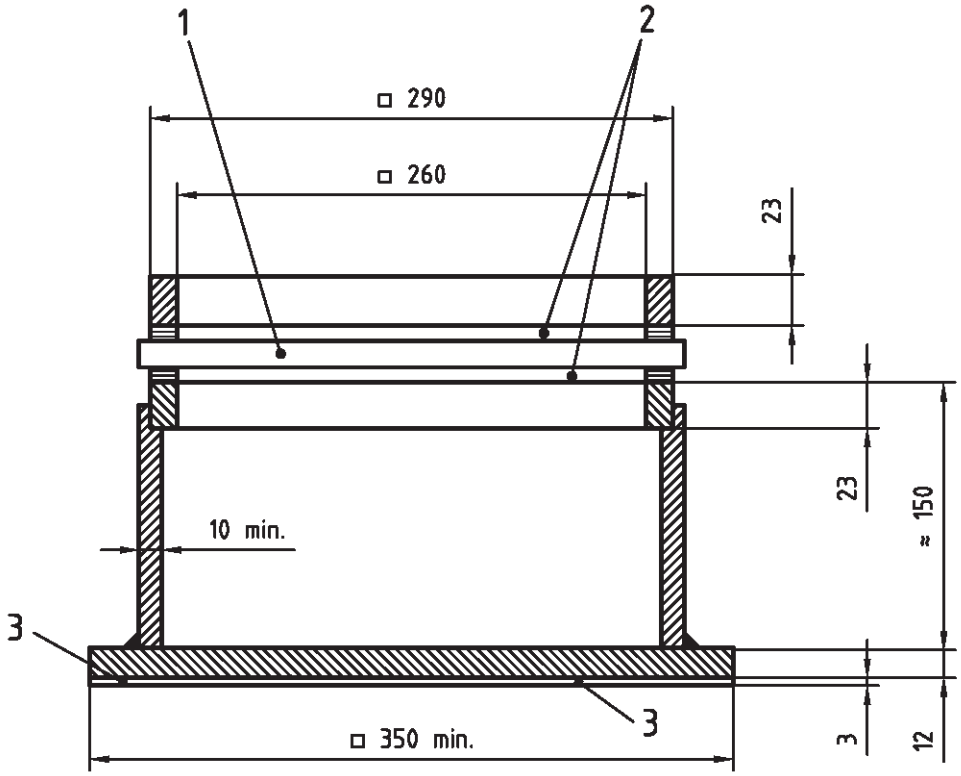
6.2.2 Means for dropping the ball freely from a height to be specified, or **means for giving the ball a velocity equivalent to that obtained by the free fall**.

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

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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**
$2{,}5 \leq e \leq 4{,}5$	0 min 40 s	2 min 0 s
$4{,}5 < e \leq 6{,}5$	1 min 0 s	2 min 0 s
$6{,}5 < e \leq 8{,}5$	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.

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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.

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— 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.

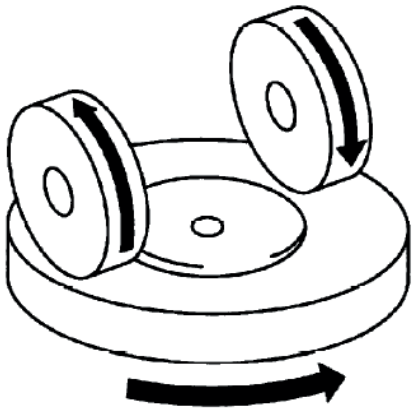

Figure 2 — Diagram of abrading instrument

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.

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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.

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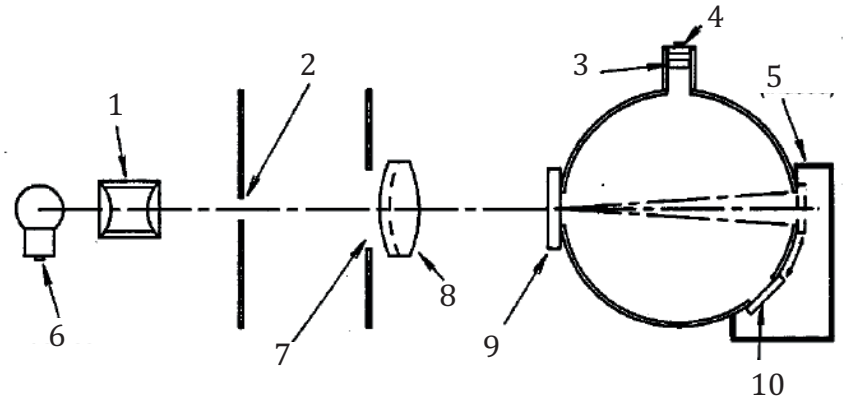

Key

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.

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Lower the vacuum nozzle and adjust its height to 1 mm above the refacing stone surface with a gage having a thickness equal to 1 mm or a gage pin having a diameter equal to 1 mm. After setting the height of the vacuum nozzle, ensure the rear vacuum nozzle does not contact the refacing stone. Set the vacuum suction force so that a residual pressure of 13,7 kPa (137 millibar) or lower results. Lower the arms so the wheels contact the surface of the ST-11 refacing stone. Reface the wheels for 25 cycles.

After refacing, use a soft bristle, anti-static brush to lightly brush the wheel surfaces to remove any loose particulate matter. A brush found suitable for this purpose is a soft-fibre, static-dissipative brush manufactured from an acrylic fibre (0,04 mm filament diameter) that has been chemically bonded with a layer of copper sulphide to produce an electrical resistance of $3 - 5 \times 10^{-4}$ ohms per centimetre.

New wheels or wheels trued using a diamond tool refacer (such as Taber Diamond Wheel Refacer, or equivalent), shall firstly be broken in with 100 cycles on the fine side of the ST-11 refacing stone followed by a test on the material to be evaluated (results to be discarded).

The fine side of the ST-11 refacing stone has a limited life and shall be replaced after 7 500 cycles (approximately 300 refacings).

A thin fin of wheel material is sometimes formed on the left hand edge of the wheel as the main body of the wheel wears down. To remove, gently rub the edge of the wheel using your gloved finger prior to refacing. Avoid touching the running surface of the wheel.

The maximum allowed time between refacing and testing shall not exceed 2 min.

8.5 Procedure

The abrasion test shall be carried out on both inside and outside surfaces of the safety glazing material except in the case where both surfaces are comprised of glass. In this case it shall be carried out only on the outside surface.

8.5.1 Cleaning. Before testing, remove any protective masking material from the test pieces. If required, clean the test pieces using a practice recommended by the manufacturer, or if none is recommended, clean the test pieces in the following manner:

a) Using an Isopropyl alcohol (IPA) soaked lint free cloth, gently wipe both surfaces of the test piece in a linear motion to remove any remaining particulate. For those materials where IPA influences the surface characteristics or does not yield a satisfactory result, use a cleaning solution of water with a commercial (e.g. dish-washing) detergent added or a cleaning solution that is compatible with the test piece. First, wipe the test piece vertically; then wipe the test piece horizontally; and as a final cleaning step, wipe the edges.

b) Rinse with distilled, deionized, or demineralised water.

c) Dry by pressing lightly between two linen cloths, or blow dry with clean air or nitrogen.

Inspect to confirm that there are no water spots or other residue before haze measurement.

Any treatment with ultrasonic equipment shall be avoided.

After cleaning, the test pieces shall be handled only by their edges and shall be stored to prevent damage to, or contamination of, their surfaces. It is recommended that latex gloves be worn at all times throughout this test.

8.5.2 Conditioning. Condition the test pieces for a minimum of 48 h at 23 °C ± 2 °C and (50 ± 5) % relative humidity, unless otherwise specified. Begin testing within 5 min after removal from conditioning.

When not in use, the abrasive wheels shall be stored in the same conditions of temperature and humidity.

8.5.3 Initial haze measurement. Place the unabraded test piece in the hazemeter test piece holder with the side to be abraded facing the entrance port of the integrating sphere. Measure the light scattered

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(initial haze) at a minimum of four equally spaced points along the track in accordance with Formula (3). Average the results for each test piece. The angle between the normal to the surface of the test piece and the axis of the beam shall not exceed 8°. In lieu of the four measurements, an average value can be obtained by rotating the test piece uniformly at 3 r/s or more. Take the four readings indicated in Table 2.

8.5.4 Abrasion. Mount the test piece on the abraser turntable platform with the side to be abraded facing up. The test piece shall be mounted at a 45° angle from the front of the machine as shown in Figure 4. Secure using the clamp plate and nut. Select the load to be used and affix it to the abraser. Lower the vacuum pick-up nozzle and adjust the height to 1 mm above the test piece surface with a gage having a thickness equal to 1 mm or a gage pin having a diameter equal to 1 mm. After setting the height of the vacuum nozzle, ensure the rear vacuum nozzle does not contact the test piece surface. Set the counter to zero and programme the appropriate number of cycles.

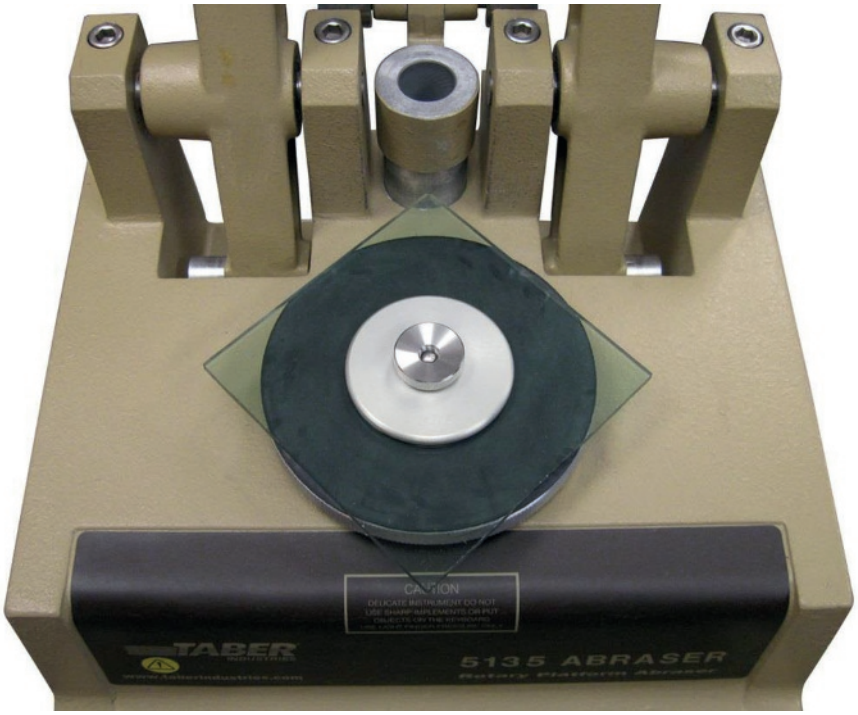

Figure 4 — Test piece mounted at 45°

For each safety glazing material, carry out three tests with the same load of 500 g, unless otherwise specified.

Start the abraser and subject the test piece to abrasion for a selected number of cycles. For outside surfaces, subject the test piece to alternatively 100 cycles or 500 cycles or 1 000 cycles (depending on the specification of the material to be tested).

For inside surfaces, subject the test piece to 100 cycles, using three new test pieces.

The abrasion test of safety glazing material shall be carried out under the same conditions as those which were used to condition the test pieces and abrasive wheels prior to the abrasion test.

8.5.5 After abrasion, handle the test pieces by their edges to prevent contamination of their surfaces. Using a soft bristle, anti-static brush, lightly brush off any debris adhered to the surface of the test pieces or alternatively rinse the test pieces with distilled, deionized, or demineralised water. Clean the test pieces following the procedure described in 8.5.1.

After each test, inspect the vacuum nozzle for debris and clean as required by using a brush, vacuum cleaner, or other suitable means.

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8.5.6 Final haze measurement. Place the abraded test piece in the hazemeter test piece holder with the abraded side facing the entrance port of the integrating sphere. Measure the light scattered by the abraded track (final haze) at a minimum of four equally spaced points along the track in accordance with Formula (3). If the abrasion track is not homogeneous, up to sixteen equally spaced points along the track can be measured. Average the results for each test piece. The angle between the normal to the surface of the test piece and the axis of the beam shall not exceed 8°. In lieu of the four measurements, an average value can be obtained by rotating the test piece uniformly at 3 r/s or more.

For all haze measurements, take the four readings indicated in Table 2.

Table 2 — Transmittance readings for abrasion resistance test

Reading	With test piece	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 piece
τ_3	No	Yes	No	Light scattered by instrument
τ_4	Yes	Yes	No	Light scattered by instrument and test piece

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

Calculate the total transmittance, τ_t, as shown in Formula (1):

$$\tau_1 = \tau_2 / \tau_1 \tag{1}$$

Calculate the diffuse transmittance, τ_d, as shown in Formula (2):

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

Calculate the percentage haze as shown in Formula (3):

$$haze = \frac{\tau_d}{\tau_t} \times 100 \tag{3}$$

8.6 Expression of results

Subtract the average initial haze from the average final haze, the difference representing the light scatter resulting from abrading the test piece, also called Δhaze. The report shall indicate whether Illuminant A or Illuminant C has been employed. The number of abrasion cycles and the abraser load shall also be reported.

9 Fragmentation test

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

9.1 Principle

Assessment of the nature of fragmentation resulting from the fracture of safety glazing materials.

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9.2 Apparatus

Instrument capable of causing the glazing material to break from the impacted surface, such as a hammer with a pointed head or an automatic punch.

9.3 Procedure

Fix the test piece tightly on top of second test piece of the same shape and dimensions by means of transparent adhesive tape around the periphery.

A piece of photographic paper can be placed between the test pieces.

The exposure of the photographic paper shall start not later than 10 s after the impact and terminate not later than 3 min after it. Only the deepest lines, representing the initial fracture, shall be taken into consideration.

Alternatively, the individual crack-free fragments can be examined and measured.

The examination of fragments can be made using any method validated on its ability to achieve accurate counts, and on its ability to find the correct location where the minimum counting as described in 9.4, item a, shall be done.

The impact points shall be situated as follows (see the examples in Figure 5):

Point 1, At the geometric centre of the test piece.

Point 2, Additionally for curved pieces, on the longest median at the point of maximum curvature.

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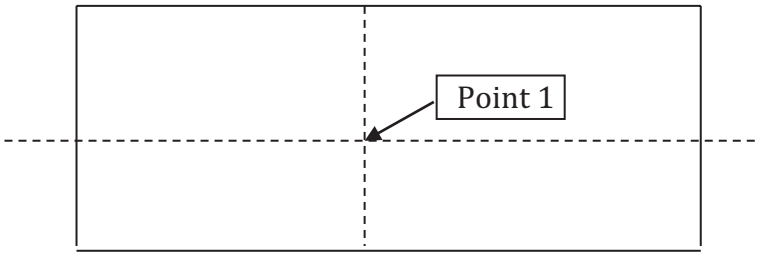
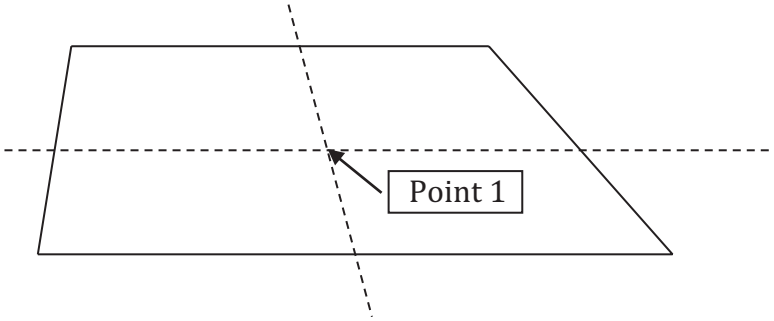
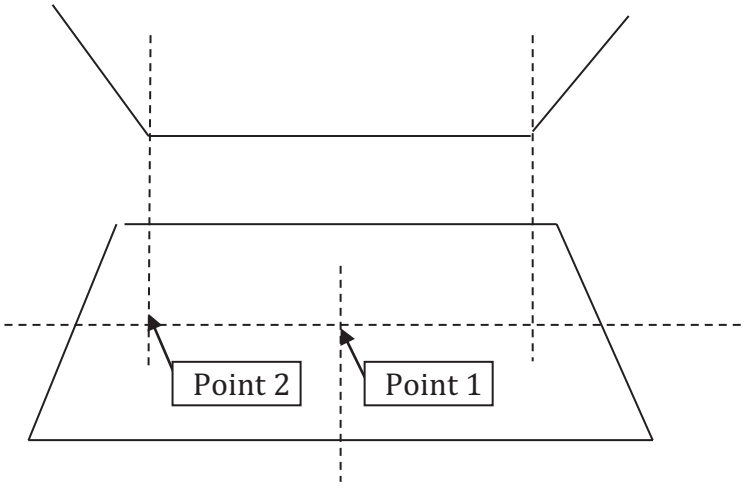


(a) Flat glass pane



(b) Flat glass pane



(c) Curved glass pane

Figure 5 — Impact points

9.4 Expression of results

Determine the fracture behaviour of safety glazing materials by reference to the size, shape, mass, and distribution of the resulting fragments by inspection of the photographic record, or by physical examination and measurement.

Record the following information, excluding fragments from within 2 cm of the edge of the test piece and within a radius of 7,5 cm from the point of impact:

a) The minimum number of particles in a 5 cm × 5 cm square area[4)].

4) A fragment extending across at least one side of the square shall count as half a fragment.

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b) The length of the longest crack-free particle[5)].

c) The weight of the largest crack-free particle.

d) The presence of any particles where the longest two edges intersect at a point.

10 Head-form test

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

10.1 Principle

Assessment of the minimum strength and cohesion of the safety glazing material under impact from a blunt, bulky object. If required, tests can be performed on whole windscreens.

10.2 Apparatus

10.2.1 Head-form weight, with a spherical or semi-spherical head made of laminated hard wood 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 6.

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

5) When a fragment extends beyond the excluded area only the part of the fragment falling outside of the area shall be assessed.

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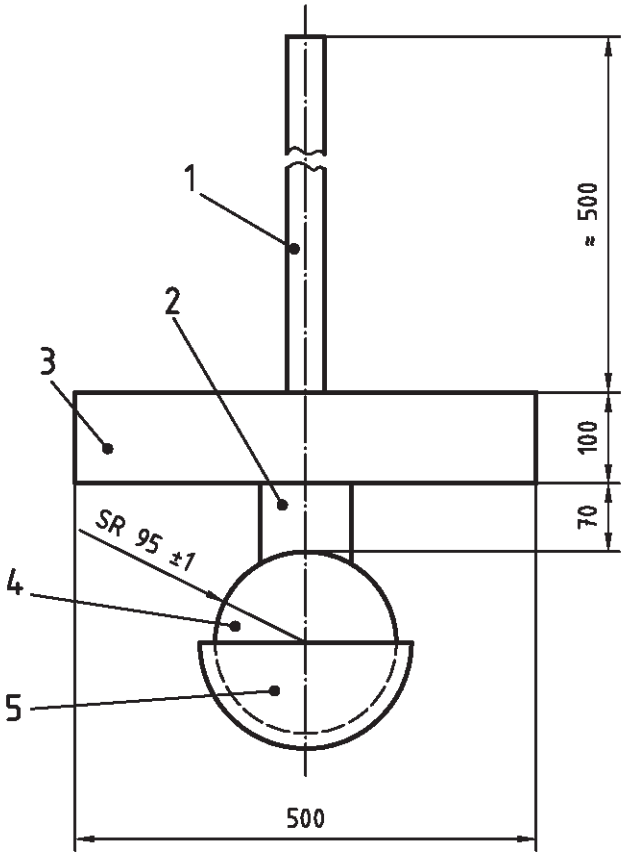
Dimensions in millimetres



Key

1 mounting rod
2 intermediate piece
3 cross-beam (optional)
4 head
5 felt cover 5 mm thick

Figure 6 — Head-form weight

10.2.2 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.

10.2.3 Supporting fixture, as shown in Figure 7, for testing flat test pieces. The fixture is composed of two steel frames, with machined edges, 50 mm wide, fitting one over the other and faced with rubber gaskets 3 mm ± 0,5 mm thick, and 15 mm ± 1 mm wide, of hardness 70 IRHD, determined 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. Alternatively, other pressing techniques can be used, e.g. hydraulic or pneumatic pressing (10.3.1).

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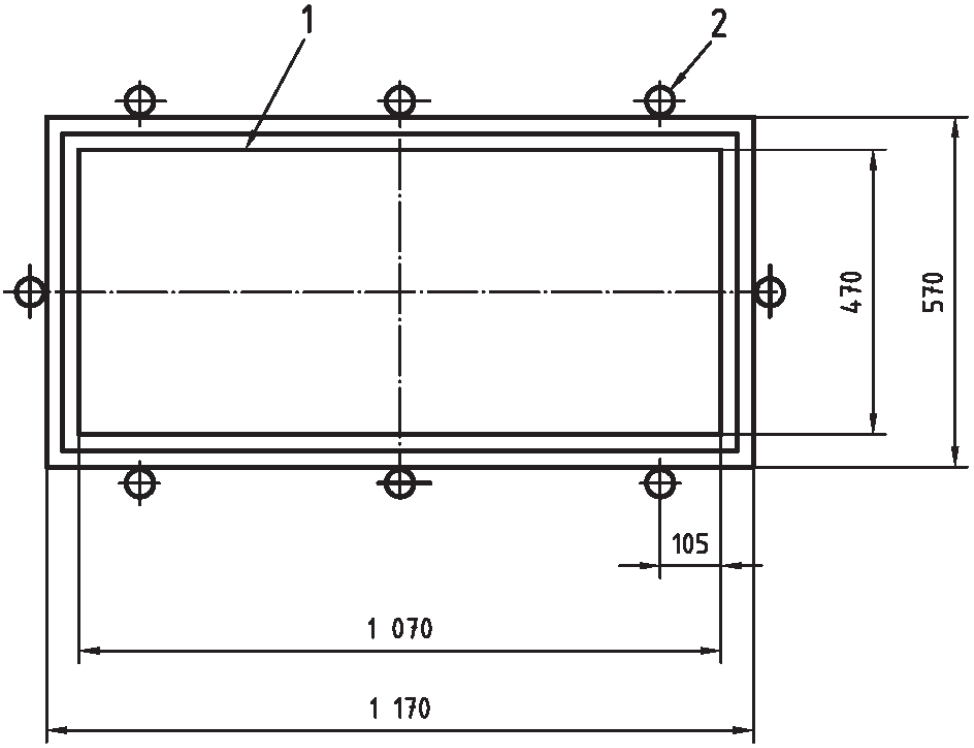
Dimensions in millimetres



Key

1 rubber gasket
2 bolt

Figure 7 — Support for head-form tests

10.3 Procedure

10.3.1 Tests on flat test piece

The flat test piece, of length 1 100 $^{+5}_{-2}$ mm and width 500 $^{+5}_{-2}$ mm shall be kept at a constant temperature of 20°C ± 5°C for at least 4 h immediately preceding the test.

Fix the test piece in the supporting fixture (10.2.3); the torque on the bolts respectively the amount of hydraulic or pneumatic pressure shall ensure that the movement of the test piece during the test will not exceed 2 mm. The plane of the test piece shall be substantially perpendicular to the incident direction of the weight.

The weight shall strike the test piece within 40 mm of its centre on that face which represents the inside face of the safety glazing material when mounted on the vehicle, and shall be allowed to make only one impact.

The impact surface of the felt cover shall be replaced after 12 tests or when damage results in exposure of the underlying head-form.

10.3.2 Tests on complete windscreen

These tests are to be conducted from the drop heights specified, including less than or equal to 1,5 m + 0/-5 mm. The test sample shall be kept at a constant temperature of 20°C ± 5°C for at least 4 h immediately preceding the test.

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Place the windscreen freely on a support shaped so that the head-form weight strikes that surface of the product which faces inward towards the passenger compartment when installed in the vehicle.

The support shall consist of a rigid piece, corresponding to the shape of the windscreen, faced with a rubber gasket 3 mm ± 0,5 mm thick and a contact width, on the glazing, of 15 mm ± 1 mm wide, of hardness 70 IRHD, measured in accordance with ISO 48.

The support shall rest on a rigid stand with a sheet of rubber, of hardness 70 IRHD and 3 mm ± 0,5 mm thick, placed in between.

Depending on the drop height selected, it might be necessary to clamp the test windscreen in place.

The surface of the windscreen shall be substantially perpendicular to the incident direction of the head-form weight.

The head-form weight shall strike the windscreen at a point within 40 mm of its centre on that surface which faces inward towards the passenger compartment when installed in the vehicle.

The impact surface of the felt cover shall be replaced after 12 tests or when damage results in exposure of the underlying head-form.

10.4 Expression of results

Evaluate the strength and cohesion of the safety glazing material under impact from a blunt, bulky object by reference to the velocities at which the test piece disintegrates or fractures without rupture.

For safety glazing material (laminated windscreens) tested in accordance with 10.3.2, evaluate the test results by reference to the dimensions and form of the fracture of the sample, rupture of the interlayer, and adherence of glass to the interlayer. Report the following results:

a) fracture of one or both glazing surfaces;

b) failure of the sample to support the head-form;

c) length of any tear occurring in the interlayer, in mm;

d) area in cm^2 of bare interlayer observed on the surface which was impacted;

e) for impacts of drop height 1,5 m or less, the distance of the circular crack nearest to the centre of impact, from the impact point, in mm;

f) for impacts of drop height 1,5 m or less, maximum breadth in mm of any partial separation of glass and interlayer along either side of a crack, measured in an area more than 30 mm from the point of impact.

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Annex A
(informative)

Vacuum pick-up nozzle modification

The vacuum pick-up nozzle referenced in 8.2.1 has a larger diameter hole bore than the standard nozzle, 11 mm versus 8 mm. A replacement nozzle is available, or the user can modify the vacuum nozzle according to the following instructions:

a) secure the nozzle with the opening aligned under the drill bit so that the drilled hole is perpendicular to the hole axis;

b) use an 11 mm drill bit, enlarge the hole taking care not to drill completely through the vacuum pick-up nozzle;

c) repeat for the second hole so that the distance between the axes of the two openings is 76,0 mm ± 1,0 mm (see Figure A.1); and

d) remove any burrs prior to use.

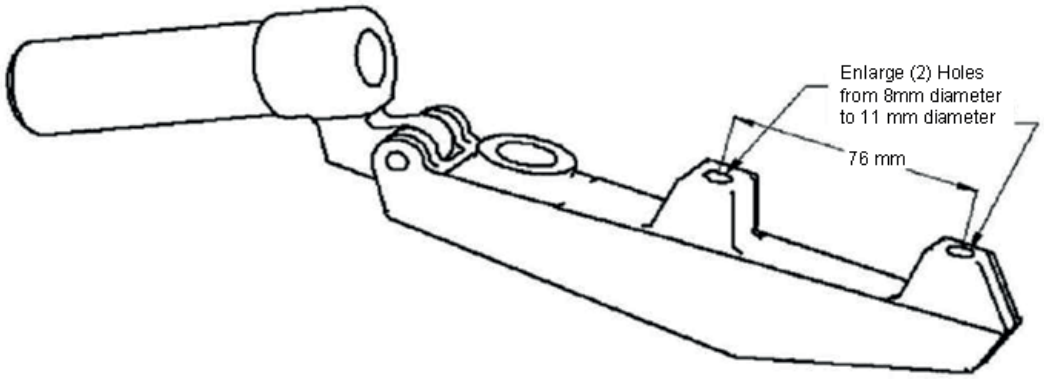

Figure A.1 — Schematic of modified vacuum pick-up nozzle

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Annex B
(informative)

Calibration verification of Taber abraser

To facilitate the verification of calibration of the Taber abraser, a kit is available from the manufacturer that provides a fast reliable system check. This kit is not meant as a substitute for regular instrument calibration. Procedures in the kit allow the user to verify:

B.1 Wheel alignment and tracking: The wheels should be spaced equally on both sides from the wheel-mounting flange to the centre of the test piece (specimen) holder. When resting on the test piece, the wheels will have a peripheral engagement with the surface of the test piece, the direction of travel of the periphery of the wheels and of the test piece at the contacting portions being at acute angles, and the angles of travel of one wheel periphery being opposite to that of the other. Wheel internal faces shall be 52,4 mm ± 1,0 mm apart and the hypothetical line through the two spindles shall be 19,05 mm ± 0,3 mm away from the central axis of the turntable (see Figure B.1).

B.2 Wheel bearings condition: The Taber abraser wheel bearings should be able to rotate freely about their horizontal spindles and not stick when the wheels are caused to spin rapidly by a quick driving motion of the forefinger.

B.3 Vacuum suction force: Air pressure in the suction device should have a residual pressure of 13,7 kPa (137 millibar) or lower, as measured by a suction gauge.

Vacuum suction force can be influenced by the condition of the collection bag, which should be emptied or replaced on a regular basis. Clean any debris that collects on the inside of the vacuum pick-up nozzle on a frequent basis. Any connection or seal leaks will also influence suction force.

B.4 Turntable platform position: The vertical distance from the centre of the pivot point of the Taber abraser arms to the top of the turntable platform should be approximately 25 mm. The turntable platform shall rotate substantially in a plane with a deviation at a distance of 1,6 mm from its periphery of not greater than ± 0,051 mm.

B.5 Turntable speed: The turntable should rotate at the speed 60 r/min ± 2 r/min or 72 r/min ± 2 r/min.

B.6 Load: The accessory mass marked 500 g shall weigh 250 g ± 1 g and the accessory mass marked 1 000 g shall weigh 750 g ± 1g.

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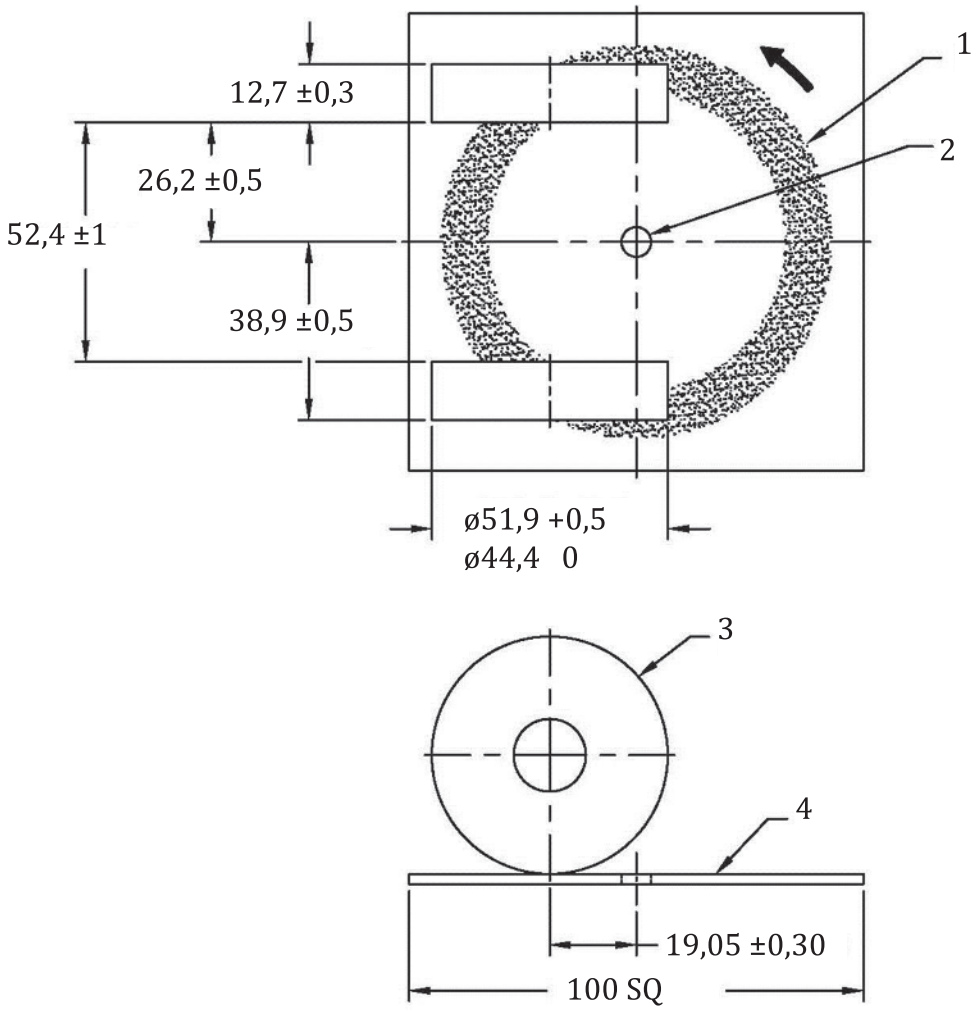
Dimensions in millimetres



Key

1 wear zone
2 center hole ø 6,5
3 abrasive wheel
4 test specimen

Figure B.1 — Diagrammatic arrangement of Taber abraser test set-up

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ICS 43.040.65; 81.040.30

Price based on 19 pages

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