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Road vehicles — Testing the abrasion resistance of automotive glazing with the windscreen wiper test

Véhicules routiers — Contrôle de la résistance à l'abrasion du vitrage automobile par un test essuie-glace

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 35, *Lighting and visibility*.

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

Introduction

The surfaces of vehicle glazing are usually subject to abrasive wear in service. This is caused by various mechanisms such as the impact of small particles (e.g. sand), the use of car wash brushes, windscreen wipers or ice scrapers, or the rolling up and down of panes of glazing with deposited dirt on them in the case of roll-up windows.

Various test methods are required in order to be able to evaluate to a sufficient extent the abrasion resistance of glazing surfaces with regard to these different mechanisms that occur in service. In addition to the abrasive wheel test [taber test (see ISO 3537, ISO 15082 and UNECE R43)], the sand drop test (see UNECE R43) and the more recent car wash test (see ISO 15082 and UNECE R43) that have been established in abrasion testing of vehicle glazing for many years, a method is to be standardized that simulates the abrasion that results from the use of windscreen wipers. This is significant for the evaluation of windscreens in particular, but also for other panes of glazing.

Road vehicles — Testing the abrasion resistance of automotive glazing with the windscreen wiper test

1 Scope

This document specifies a method for determining the resistance of a glazing surface to abrasion by a wiper rubber under the influence of a standardized test dust suspension.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 12103-1:2016, *Road vehicles — Test contaminants for filter evaluation — Part 1: Arizona test dust*

3 Terms and definitions

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

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

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

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

3.1
individual test
single experiment in which a test piece is subjected to 20 000 *wiping cycles* (3.3)

Note 1 to entry: Two test pieces can always be tested at the same time in a test procedure.

3.2
complete test
consists of three *individual tests* (3.1), i.e. a test on three test pieces

Note 1 to entry: One of the three individual tests may be repeated if areas with differing abrasion occur [see also *chatter marks* (3.7)]. Every valid individual test shall fulfil the requirements in order to fulfil the requirements for a set of test pieces.

3.3
wiping cycle
single forward and backward movement of the abrasion testing device carriage

3.4
stroke length
travel distance of the carriage or bridge

Note 1 to entry: The stroke length corresponds to half a *wiping cycle* (3.3).

3.5
wiper track length
travel distance of the wiper rubber lip

3.6
wiper rubber holder
mounting device for the wiper rubber

3.7
chatter mark
area with differing abrasion that generally has wave patterns and is caused by non-uniform, jerking motion of the wiper rubber lip

4 Principle

A wiper rubber is moved forward and backward across a glazing surface using an abrasion testing device (see 6.1). A standardized aqueous test dust suspension is used as the abrasive medium.

The surface wear is evaluated by measuring the increase in haze.

5 Test Conditions

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

— ambient temperature: (20 ± 5) °C;

— atmospheric pressure: 86 kPa to 106 kPa;

— relative humidity: (60 ± 20) %.

6 Apparatus

6.1 Abrasion testing device

The apparatus is presented in Figure 1 a) to Figure 1 c) and includes the following individual components as a minimum:

— an abrasion testing device with a moving carriage: the moving carriage shall be set for a forward and backward motion of (37 ± 2) cycles per minute and a stroke length (half a wiping cycle) of (130 ± 5) mm;

— a wiper bridge that is mounted on the moving carriage. Self-supporting arms that the wiper rubber holders can be mounted on are attached to the wiper bridge;

  The height of the wiper bridge is to be selected in such a way that the self-supporting arms are at an angle of (45 ± 5)° in the final test apparatus (see 9.1).

— two wiper rubber holders that are suitable for inserting two commercially available wiper rubbers and that can be set in such a way that the test pieces can be subjected to a load of (15 ± 0,5) g per cm of wiper rubber length (see 7.4);

— two specimen boxes (see 6.3) that the test pieces are placed in and that are filled with the standardized aqueous test dust suspension (see 9.3);

— various spacer plates in the dimensions of the test pieces, but with different thicknesses, that are used for compensation of different test piece thicknesses;

It is necessary that the bottom of the specimen box and the test piece surface to be tested are at the same height.

It is to be ensured that the underside of the test piece placed on the spacer plates is not scratched, e.g. by adding a soft film with a maximum thickness of 100 µm[1)] to the surface of the spacer plates.

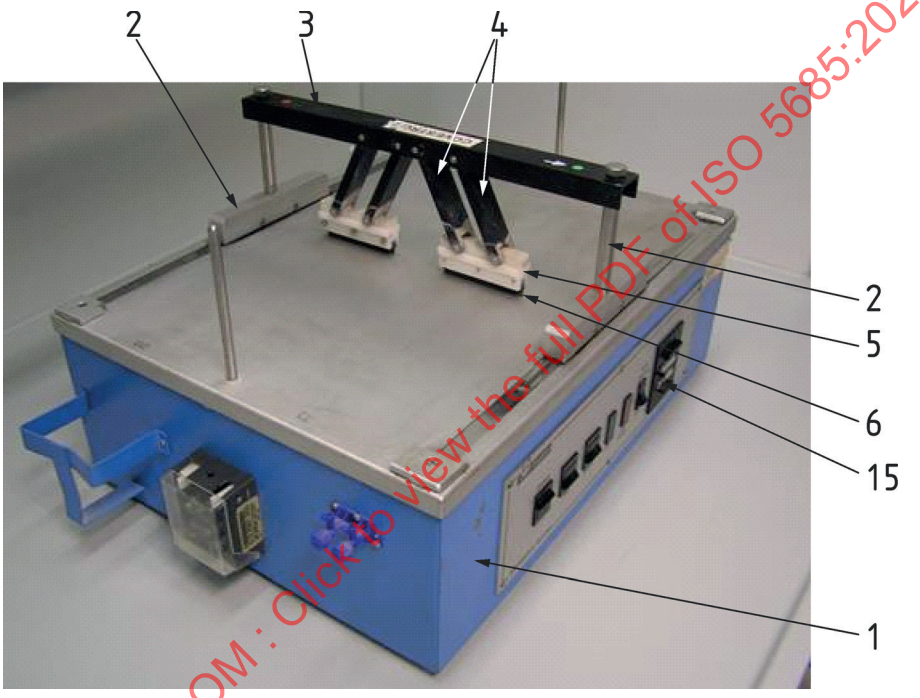
NOTE 1 The spacer plates can be made from the specimen box material, for example.

— five inlay plates to clamp the specimen boxes;

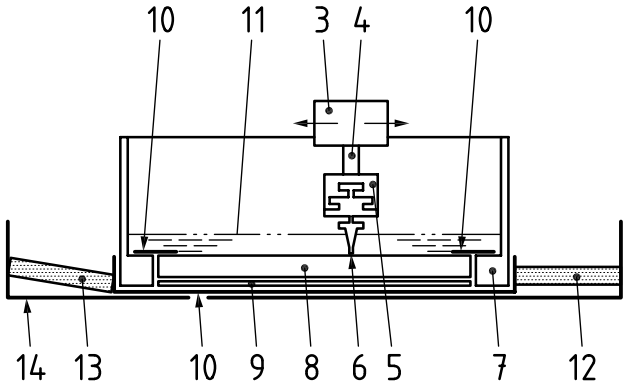
NOTE 2 One of the inlay plates [No. 13 in Figure 1 b) and Figure 1 c)] can be used as a clamp on one of the sides of the specimen box that is perpendicular to the direction of movement in order to increase the clamping effect on the specimen box.

— a stainless steel basin;

— a wiping cycle counter.

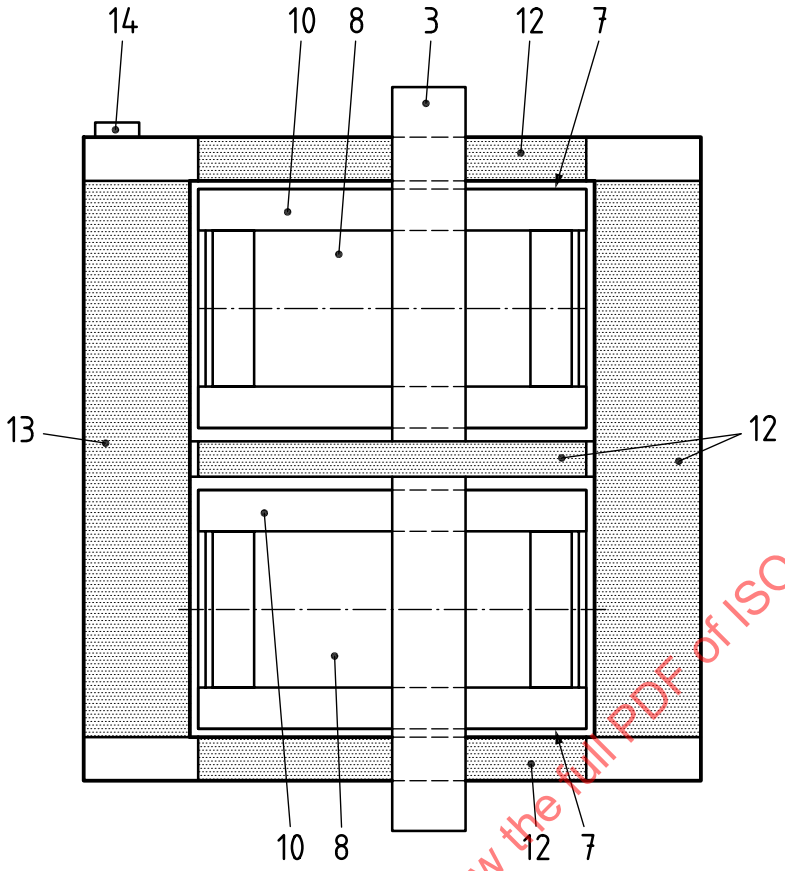


a) Example of an abrasion testing device with a moving carriage, together with components to guide the wiper rubber



b) Cross-sectional view of the abrasion testing device, with added components to hold the test pieces and the standardized test dust suspension

1) The spacer plates can be covered in a manner largely free of creases using so-called masking films, for example, which are normally used to protect hard plastic-glazing materials during storage and transport.



c) Top view of the abrasion testing device

Key

1	abrasion testing device	9	spacer plates
2	moving carriage	10	adhesive tape
3	wiper bridge	11	standardized aqueous test dust suspension
4	self-supporting arms	12	inlay plates
5	wiper rubber holder	13	clamp plate
6	wiper rubbers	14	stainless steel basin
7	specimen boxes	15	wiping cycle counter
8	test piece		

Figure 1 — Abrasion testing device

6.2 Components to guide the wiper rubber

Wiper rubber holders[2)] and wiper rubbers[3)] can be added to a commercially available abrasion testing device (e.g. a washing and scrubbing resistance tester) to create an abrasion testing device for the wiper test.

2) Suitable abrasion testing devices and wiper holders can be purchased from BYK Gardner, Geretsried, Germany. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

3) Suitable wiper rubbers can be purchased from Bosch, Bühl, Germany (CR wiper rubber, "H Stoff P32", Item No. 3.391.018.399). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

The bridge of the abrasion testing device is modified in such a way that two wiper rubber holders (see A.1) can be mounted underneath on the self-supporting arms. The design of the wiper rubbers has an influence on the wear behaviour of the test pieces and thus on the test results. Only commercially available wiper rubbers shall be used. The type of wiper rubber is to be stated in the test report.

6.3 Specimen boxes with spacer plates

Specimen boxes with the following dimensions are used; see Figure 2 a) and Figure 2 b):

Inner dimensions:

Length: (200 ± 2) mm

Width: (120 ± 2) mm

Height of sides: (55 ± 5) mm

Thickness of bottom plate: (10 ± 0,1) mm

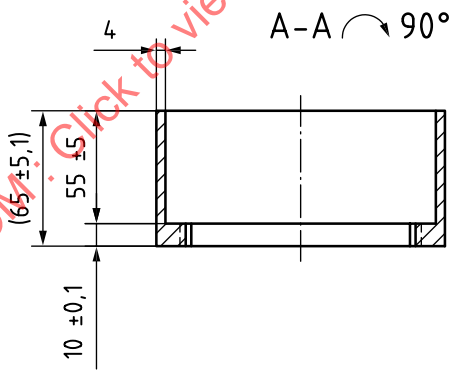
Opening for insertion of the test piece:

Length: (152 + 1) mm

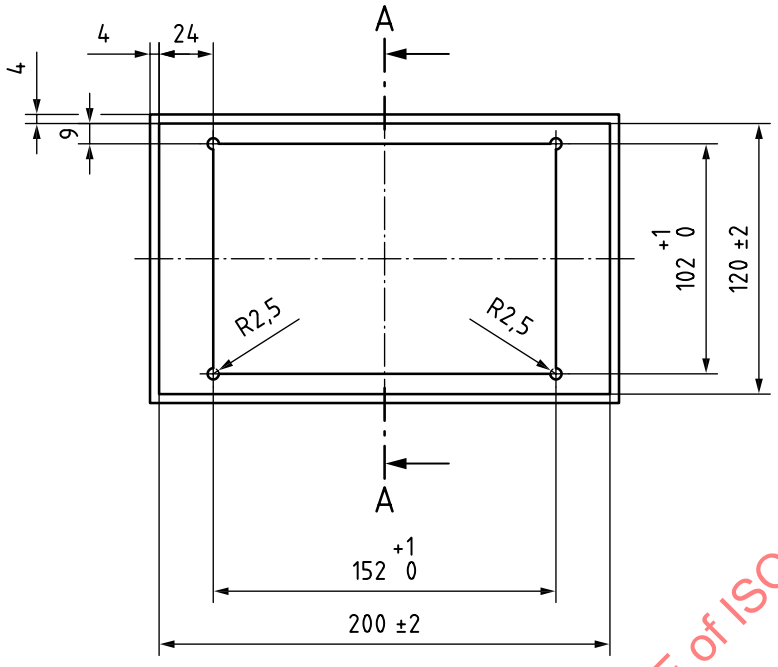
Width: (102 + 1) mm

Positioned at the centre of the specimen box, i.e. distance to specimen box walls 24 mm on each side in the longitudinal direction, 9 mm on each side along the width.

Dimensions in millimetres



a) Lateral view



b) Top view

Figure 2 — Specimen box

Spacer plates, 151,5 mm × 101,5 mm in size, that are placed underneath the test piece and are also stuck in place, compensate for the difference between the test piece thickness and the thickness of the bottom plate of the specimen box, so that the height difference is a maximum of ± 0,5 mm.

6.4 Haze measurement device

6.4.1 General

A schematic diagram of a haze measurement device, also known as a haze meter[4], is shown in Figure 3; this device consists 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 CIE 1931 standard colorimetric 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.

— An integrating sphere to collect transmitted flux; the sphere may 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 haze meter, 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°).

4) A suitable haze meter can be purchased from BYK Gardner, Geretsried, Germany. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

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

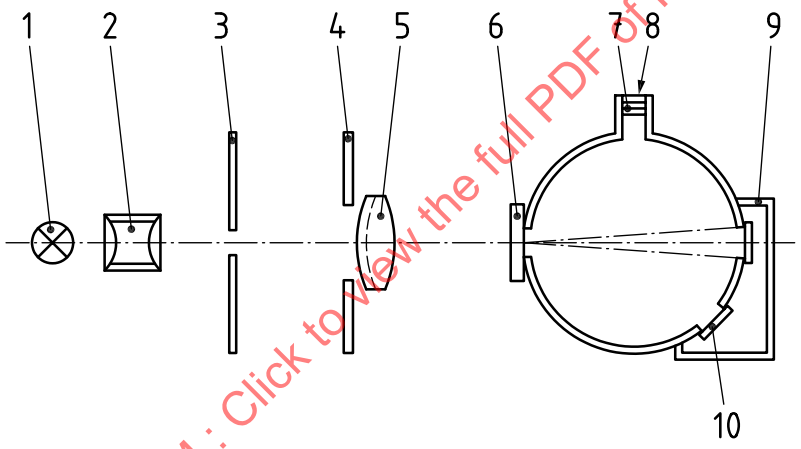
When the test piece is placed against the entrance port of the integrating sphere, the angle between the perpendicular to the test piece and a line connecting the centres of entrance and exit ports shall not exceed 0,14 rad (8°).

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 haze meter is properly adjusted.



Key

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

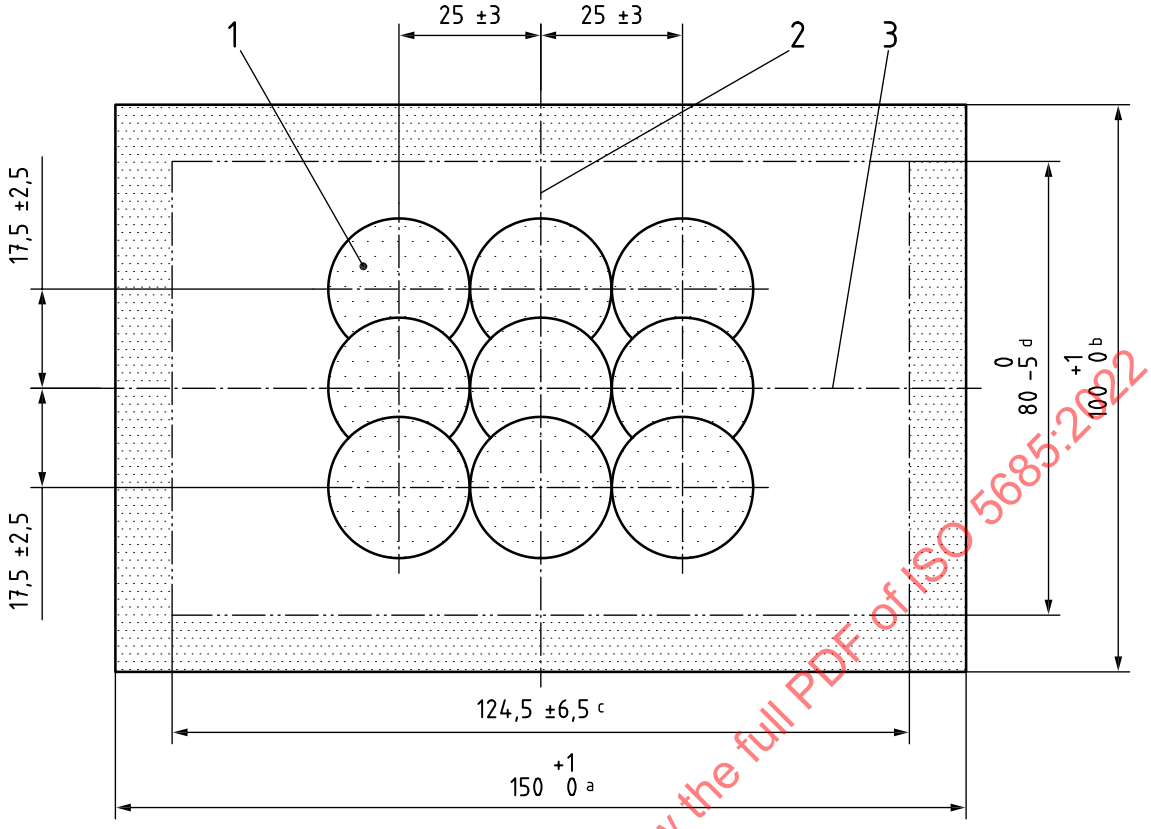
Figure 3 — Haze meter

6.4.2 Haze measurements with a haze meter

The measurements to determine the initial and final haze values shall be carried out at all nine measuring points in accordance with Figure 4. The haze is to be calculated for every measuring point using Formula (3).

NOTE It is helpful to use a template to determine the measuring positions as shown in Figure 4, in which the rings represent the inlet opening of the haze meter in this example. The actual measuring range of the haze meter can be smaller due to a lower light beam diameter (without an additional aperture).

Dimensions in millimetres



Key

1	measuring points for haze measurement	a	Test piece length.
2	axis of symmetry for wiper track length	b	Test piece width.
3	axis of symmetry for wiper track width	c	Wiper track length.
		d	Wiper track width.

Figure 4 — Positions of the measuring points

Before the haze measurement, the haze meter shall be calibrated and the zero adjustment of the haze meter shall be confirmed.

The entire testing device shall be checked against calibration standards with defined haze at regular intervals.

For all haze measurements, take the four readings indicated in Table 1.

Table 1 — 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 the instrument
τ_4	Yes	Yes	No	Light scattered by instrument and the test piece

Repeat readings for τ_1, τ_2, τ_3 and τ_4 with additional positions of the test piece specified in Figure 4 to determine uniformity.

Calculate the total transmittance τ_t as follows:

$$\tau_t = \frac{\tau_2}{\tau_1} \tag{1}$$

Calculate the diffuse transmittance τ_d as follows:

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

Calculate the percentage haze as follows:

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

where H is the haze.

If haze measurements are carried out with other testing devices or differing methods, the results are to be corrected if necessary, in order to achieve conformity with the results from the use of the apparatus described above.

7 Preparation of the abrasion testing device

7.1 Settings of the abrasion testing device

The following settings are to be made on the abrasion testing device:

1) wiping cycles: (37 ± 2) cycles per minute (one wiping cycle corresponds to a double stroke);

2) stroke length: (130 ± 5) mm (corresponds to half a wiping cycle).

Two test pieces can be subjected to abrasion at the same time.

To ensure the wiper test is carried out in a uniform manner, the positions of the specimen boxes are to be switched (see Clause 10) and markings are to be made on the abrasion testing device, specimen boxes and test pieces in accordance with 7.2.

7.2 Setting up the abrasion testing device

a) The specimen boxes are to be positioned in the abrasion testing device in a traceable manner by using corresponding markings for the switching of the positions of the specimen boxes after 10 000 wiping cycles in particular (see 10.2) [e.g. A and B as markings for the two specimen boxes and a and b for the positions of the specimen boxes in the abrasion testing device (see 10.2.2 and 10.2.3)].

b) The test pieces are to be marked on the reverse side of the wiping area.

c) It is recommended to use only test pieces that are coated on both sides to avoid scratches on the reverse side of the test pieces. If this is not possible, the samples should be covered with a protective soft film with a maximum thickness of 100 µm on the rear, apart from when the haze measurement is being carried out.

d) Covering of the reverse side is also recommended for test pieces that are coated on both sides.

e) The wiper bridge is also to be marked (e.g. with a direction arrow) to ensure that it is always inserted in the same position.

f) It is recommended to carry out the test procedure regularly on reference samples made of hard plastic with known coating systems (hard coating) to ensure that a homogeneous abrasion pattern is created and that the test results are reproducible. Commercially available sample plaques[5] can be used for this purpose.

g) When using the abrasion testing device for the first time or using a new wiper bridge, 20 000 cycles shall be carried out to prepare the abrasion testing device for use. The reference samples shall then be tested.

h) It is recommended to carry out regular maintenance of the abrasion testing device in accordance with the specifications of the device manufacturer[6]. A control sheet for the abrasion testing device (see A.3 and A.4) can be used for convenient documentation of the number of tests carried out.

Wear-related errors such as the following can occur that lead to changes in the wiper track length, that can be detected by manual checking and that can be rectified by replacing the relevant components of the abrasion testing device:

— in the area of the self-supporting arms: enlarging of the drill holes, wear of the split pins (see also 7.5 and 7.6),

NOTE 1 In the delivered state, the lower drill holes in the wiper bars are 0,5 mm larger than the corresponding split pins.

— in the drive of the abrasion testing device: wear of the deflection ring.

NOTE 2 Wear of the deflection ring leads to regular shaking of the abrasion testing device; this is particularly noticeable when operators place their hand on the side of the abrasion testing device.

7.3 Inserting the wiper rubber into the wiper rubber holder

The design of the wiper rubbers has an influence on the wear behaviour of the test pieces and thus on the test results. Only commercially available wiper rubbers shall be used. The type of wiper rubber is to be stated in the test report.

The wiper rubber holder shall be suitable for the profile of the wiper rubber. The maximum possible length of the wiper rubber is 80 mm (see 7.4 regarding the length tolerance). The wiper rubber shall not have any lateral clearance after is it fastened in the wiper rubber holder, and there shall be no squashing of the insertion head of the wiper rubber (see A.1).

It is to be checked whether the wiper rubber can be easily pulled in without the use of force and without strain. The wiper rubber lip shall not be touched.

NOTE 1 The BOSCH CR wiper rubber "H-Stoff P32"[7] is fed with its lowest guide groove into the wiper rubber holder (see Figure 5).

5) Suitable sample plaques, which were also used in the round robin test (see Annex B), are available from Covestro, Leverkusen, Germany (Makrolon® AR 8099) or KRD Coatings, Bardowick, Germany (KASI® SunFlex.). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

6) BYK Gardner recommends that maintenance be carried out by the device manufacturer every 1 000 000 cycles, which corresponds to 50 tests. The stroke length can be checked as part of this.

7) A wiper rubber holder for CR wiper rubber/BOSCH, "H-Stoff P32", article no. 3.391.018.399; manufacturer: Robert Bosch GmbH, 77813 Bühl, Germany is available commercially This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

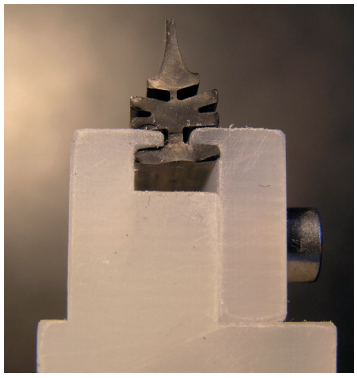


Figure 5 — Insertion of the wiper rubber

If other wiper rubbers are used, the wiper rubber holder shall be suitable or adapted for them. The type of wiper rubber used is to be stated in the test report (see Clause 14).

The holder shall be opened wide enough so that the wiper rubber can be easily pulled in.

It is to be ensured that the wiper rubber lip is not damaged. The wiper rubber is to be secured to prevent it sliding out of the wiper rubber holder by tightening the screws on the wiper rubber holder.

The wiper rubber shall be installed so that it is smooth and without waves or deformation; this is to be checked visually.

New wiper rubbers are to be used for each test.

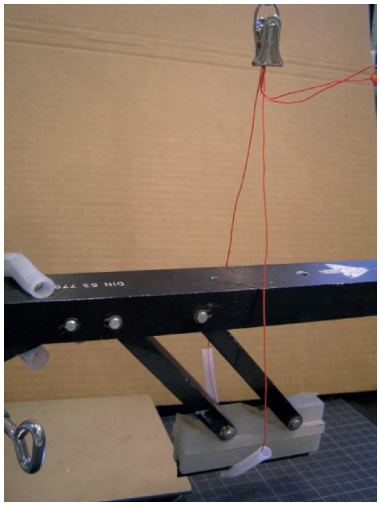
NOTE 2 As a result of the switching of specimen boxes containing test pieces after half of the total of 20 000 cycles, a wiper rubber carries out 10 000 cycles on one test piece and 10 000 cycles on the other test piece (see Clause 10).

7.4 Load weight of the wiper rubber

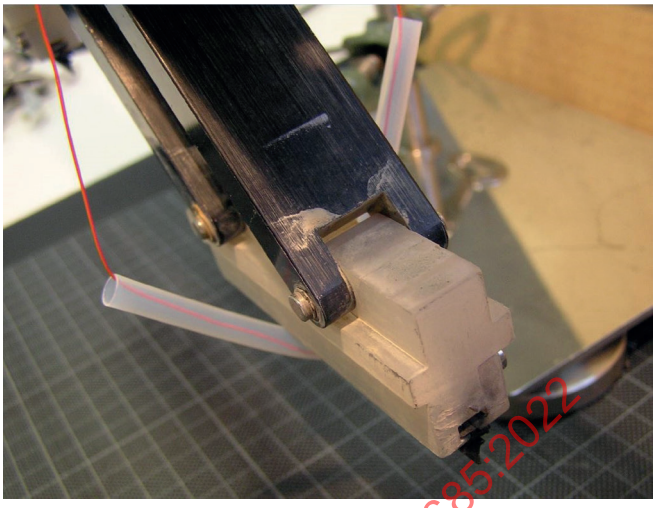
The load weight shall be (15 ± 0,5) g/cm [e.g. (120 ± 4) g for a wiper rubber length of 80 mm]. If the load weight is too low, the length of the wiper rubber can be adjusted. However, a minimum length of the wiper rubber of 75 mm shall be adhered to. If the length of the wiper rubber is adapted to adjust the load weight for the test to be carried out, a tolerance of ± 0,5 mm for the wiper rubber length is to be adhered to.

The load weight of the wiper rubber is to be measured before each test using a spring scale[8] [see Figure 6 a) and Figure 6 b)].

8) A suitable spring scale is available from Pesola, Schindellegi, Switzerland (e.g. type PESOLA 40300), for example. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.



a) Lateral view



b) Front view

Figure 6 — Measurement of the load weight of the wiper rubbers

NOTE This is another check of the freedom of movement of the wiper guidance (see also 7.5).

7.5 Movement of the wiper rubber on the test piece

In the windscreen wiper systems installed on current vehicle models at the time of preparation of this document, the wiper rubber runs approximately 2,5 mm to 3 mm behind the wiper bridge (see Figure 7).

Dimensions in millimetres

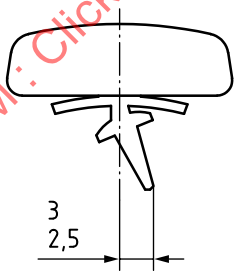


Figure 7 — Lag of a wiper rubber on a real windscreen

This results in smooth motion over the test piece by the lip edge of the wiper rubber.

To ensure wiping that corresponds to reality, the lip edge of the wiper rubber shall be pulled exactly across the test piece in the abrasion testing device.

In contrast with the wiper arm assemblies currently in practical service, the wiper rubbers are moved using comparatively longer self-supporting arms in the abrasion testing device. Possible wear of the fastening elements of the wiper rubber holder (drill hole or split pin) can also lead to changes in the lag (see also 7.6). In the delivered state, the lower drill holes in the wiper bars are 0,5 mm larger than the corresponding split pins. As wear progresses, the clearance in the drill hole increases. This leads to greater tilting of the wiper rubber holder: the lag of the wiper rubber increases. This reduces the length of the wiper track. As a result, the length of the wiper track is a good parameter for monitoring wear on the device. In the case of a deviation of greater than 1,0 mm relative to the difference obtained before first use of the abrasion testing device between the wiper track length and the stroke length (see 7.6), maintenance and/or repair is to be carried out.

For this reason, clearance in the entire wiper guidance (self-supporting arms and wiper rubber holders) of the abrasion testing device is to be checked at least every 5 tests (see A.3) by means of the wiper track length (see 7.6).

7.6 Checking the wiper rubber guidance

Checking of the wiper rubber guidance involves determining the stroke length and the wiper track length.

To check the wiper rubber guidance, the ratio of the stroke length (bridge travel distance) to the travel distance of the wiper rubber lip on the test piece shall be checked at regular intervals. The stroke length (bridge travel distance) shall be determined again at least every 1 000 000 cycles. Checking of the wiper track length is to be carried out at least every 100 000 cycles (see A.3).

— Determination of the stroke length: a sample plaque (e.g. glass or coated plastic) is to be placed in the specimen box. The stroke length is determined using marked lines, for example, at the turning points of the bridge and/or carriage that the bridge is mounted on, and measurement of the distance between these marks.

— Determination of the wiper track length: this can be carried out, for example, by lightly dusting the plaque with fine dust (e.g. chalk or soot), wiping for six to ten cycles and measuring the length of the area where dust was cleared or by measuring the abrasion path of the previous wiping test.

The difference between the determination of the wiper track length and the stroke length provides the lag of the wiper rubber lip. As a result of this lag of the wiper rubber (see Figure 7), the wiper track of wiper rubber types currently in use is approximately 2,5 mm to 3 mm shorter than the stroke length on each test piece side in the area around the reversal of the direction of motion. The total wiper track length is thus between 4 mm and 7 mm shorter than the stroke length of the bridge when the abrasion testing device is first used (taking into account a measurement tolerance of ±1 mm).

The difference between the stroke length and wiper track length increases as a result of wear during further operation of the wiper bridge. Due to the greater tilting of the wiper rubber holder that results, the wiper rubber blade is flatter in the area of the wiper rubber lip when it is being moved across the test piece. A greater build-up of test dust in front of the wiper blade can occur in this case. If there is an increase in the difference between the stroke length and wiper track length of greater than 1,0 mm relative to the first checking of the wiper rubber guidance, checking and possibly also repair of the abrasion testing device is necessary. The wiper rubber guidance shall be checked (by determining the wiper track length and the stroke length) after every technical modification to the testing device, e.g. maintenance, repair, replacement of parts with the exception of the wiper rubbers. Replacement of the wiper rubbers does not make it necessary to check the wiper rubber guidance as long as the type of rubbers has not changed. The results of this check are to be recorded.

8 Preparation of the test pieces

8.1 General

Before the test pieces are inserted, they shall be cleaned and conditioned and their initial haze shall be measured.

The test pieces shall be flat and have a length of 150^{+1}_{0} mm and a width of 100^{+1}_{0} mm.

The test piece thickness shall be between 3 mm and 10 mm. When the test pieces are being placed into the specimen boxes, the different thicknesses are compensated for using spacer plates (see 8.5).

NOTE Test pieces of more than 10 mm thickness can be tested if the specimen boxes are relined accordingly.

8.2 Cleaning the test pieces

Before the test, all masking films that are normally used to protect hard plastic-glazing materials during storage and transport are to be removed 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 sample. 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 ultra-sonic 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.

8.3 Conditioning of the test pieces

The test pieces are to be conditioned for at least 24 h at (23 ± 2) °C and (50 ± 5) % relative humidity.

The haze measurement is to be started within 5 min of removal of the test pieces from the conditioning environment.

8.4 Measurement of the initial haze of the test pieces

The test piece that has not yet been subjected to abrasion is to be held directly in front of the entrance port of the integrating sphere in such a way that the side to be abraded faces the entrance port. The scattered light (initial haze) is to be measured at nine points in a defined area on the test piece (see 6.4.2).

The angle between the normal to the surface of the test piece and the axis of the light beam shall not exceed 8°.

The measured values are to be documented in a test record (see A.2 for an example).

A mean value of the test results is to be calculated for every test piece.

8.5 Insertion of the test pieces into the bottom opening of the specimen boxes

To ensure that the test piece is at the same height as the bottom plate of the specimen box, the height of the test piece shall be compensated with spacer plates if necessary, depending on the thickness of the test piece (see 6.1 and 6.3).

The test piece is affixed in the specimen box with a waterproof adhesive tape[9] in such a way that the adhesive tape, which sticks to all four side walls of the specimen box, has an overlapping strip at the edge of approximately 0,5 cm width on the test piece, with the result that a wiping area of 8,5 cm to 9,0 cm

9) A suitable adhesive tape (cloth tape) is available from Tesa, 22848 Norderstedt, Germany (waterproof cloth tape, art. No. 4688). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

width and 13,5 cm to 14,0 cm length remains uncovered on the test piece [see Figure 8 b)]. If the adhesive tape has a width of 50 mm, it is recommended to cut it in half along its length before sticking it in place [see Figure 8 a)]. To ensure that no test dust (see 9.3) can collect in the adhesive bond, it is to be ensured that no pockets form when sticking the tape in place.

After the test piece has been placed into the specimen box, the bottom of the box is to be completely sealed with adhesive tape from the outside.

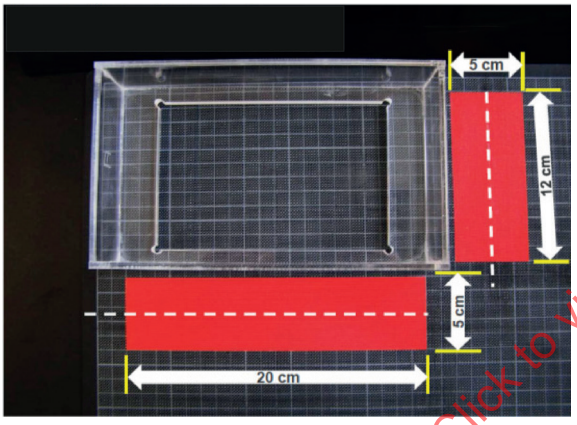
NOTE In the case of an adhesive tape width of 50 mm, this adhesive seal can be carried out using three longitudinal strips of tape arranged over the bottom surface [see Figure 8 c)].

The outside is sealed in this way:

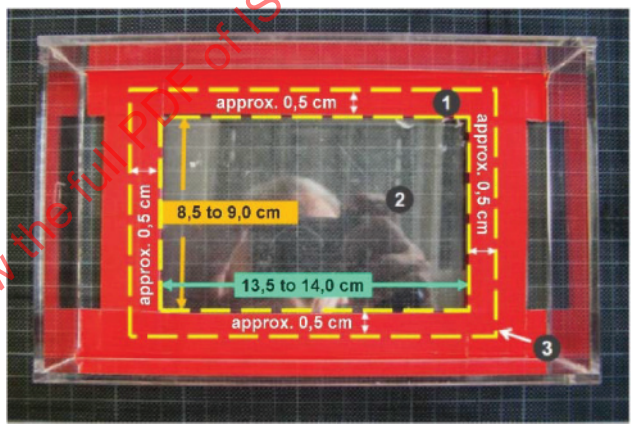
1) to achieve water tightness;

2) to ensure that the test piece cannot fall out of the bottom of the specimen box;

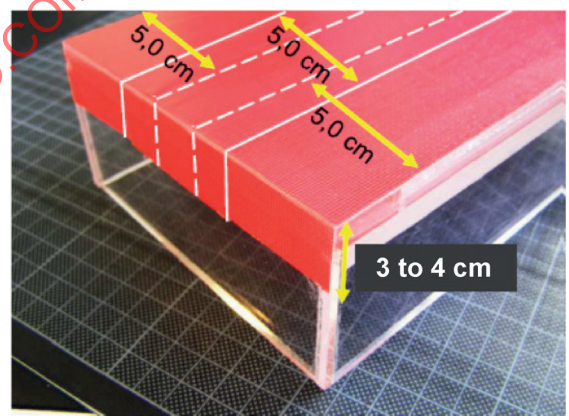
3) to achieve better stability of the adhesive bond between the test piece and the sidewalls of the specimen box.



a) Preparation for mounting test piece



b) Position of the adhesive tape



c) Outer seal

Figure 8 — Insertion of the test pieces into the specimen boxes

9 Completion of the abrasion testing device

9.1 Positioning of the specimen boxes in the abrasion testing device

Both specimen boxes are placed into the abrasion testing device and affixed on all sides of the specimen box using inlay plates [see Figure 1 c)]. The exact orientation depends on the height of the wiper bridge and shall be implemented in such a way that the fields of the wiper tracks have a maximum lateral offset of 3 mm relative to one another after switching the positions of the specimen boxes (see 10.2).

It is recommended to affix the specimen boxes on three sides using inlay plates and to clamp the fourth side using a suitable plate [see Figure 1 b) and Figure 1 c)].

If not already prepared in this way by the manufacturer, the bridge height is to be selected so that the wiper arms are at an angle of (45 ± 5) ° (see Figure 9).

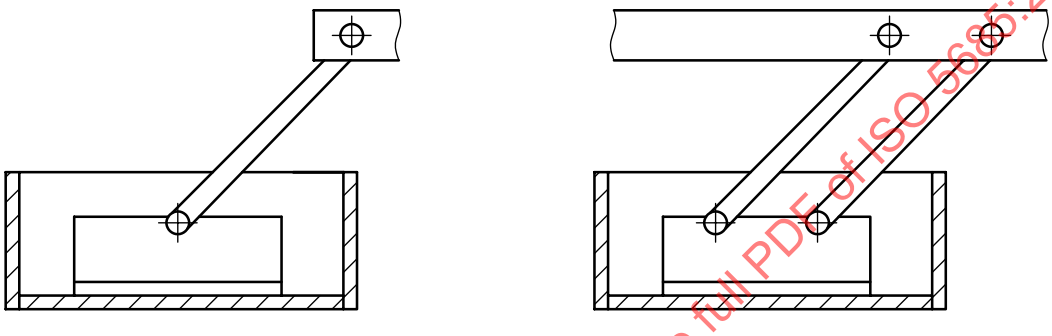


Figure 9 — Position of the wiper arms

9.2 Mounting of the wiper bridge with wiper rubber holders and wiper rubbers on the abrasion testing device

The bottom of the abrasion testing device, the wiper bridge and the inserted test pieces shall be oriented parallel to one another; this is to be checked using a spirit level.

The wiper rubbers shall be positioned in such a way that they move in the wiping area of the test pieces during the wiping procedure (see 8.5).

It shall be ensured that there is sufficient separation distance to the adhesive strips and that the wiper rubbers are parallel to the test pieces. The wiper rubbers shall be in contact with the test pieces in a uniform, planar manner; this can be checked by visual inspection (e.g. using a torch to identify a “light gap”).

9.3 Filling the standardized test dust suspension into the specimen boxes

(5,0 ± 0,2) g of test dust (in accordance with ISO 12103-1:2016, A4 Coarse)[10] is to be stirred into (195,0 ± 1,0) g of water (with a hardness of less than 205 mg/l after evaporation); this suspension is to be freshly prepared before it is filled into each specimen box in order to test a single test piece. A new standardized aqueous test dust suspension is to be freshly mixed for every additional test piece.

10) Suitable test dust can be purchased from Fiatec Filter und Aerosoltechnologie, Mainleus, Germany, for example. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

10 Carrying out the abrasion process

10.1 Carrying out the first 10 000 wiping cycles

Set the counter on the abrasion testing device to 10 000 wiping cycles and start the abrasion testing device. After 10 000 wiping cycles, the abrasion testing device automatically switches off.

10.2 Switching the positions of the specimen boxes after 10 000 wiping cycles

10.2.1 General

After 10 000 wiping cycles, the positions of the specimen boxes are switched on the abrasion testing device. The standardized test dust suspension is not changed. The wiper pivot joints on the bridge and the wiper rubber holders are to be checked manually for freedom of movement. If this movement is not free (e.g. due to test dust in the pivot joints), the entire test procedure is to be repeated with a new test piece and a new suspension after the cause of the problem has been rectified (e.g. by cleaning).

10.2.2 Switching the positions in the case of parallel orientation of the specimen boxes

Once the wiper bridge has been removed, box A occupies position b in the abrasion testing device and box B occupies position a in the abrasion testing device. During this step, the orientation of the specimen boxes relative to the abrasion testing device shall be preserved (see Figure 10).

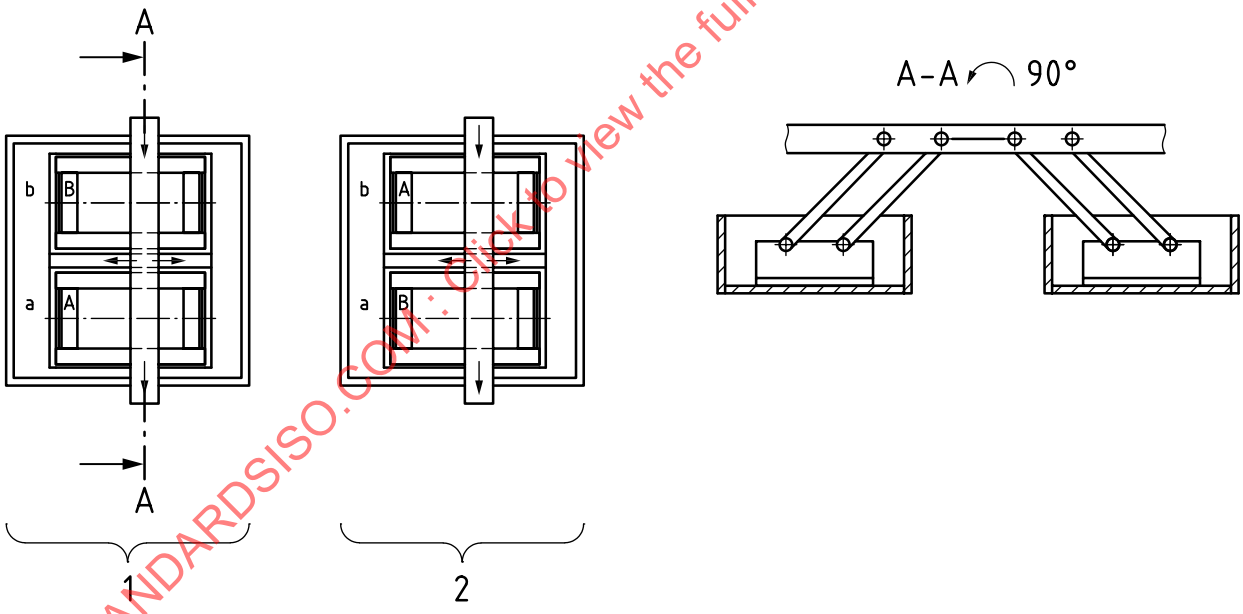


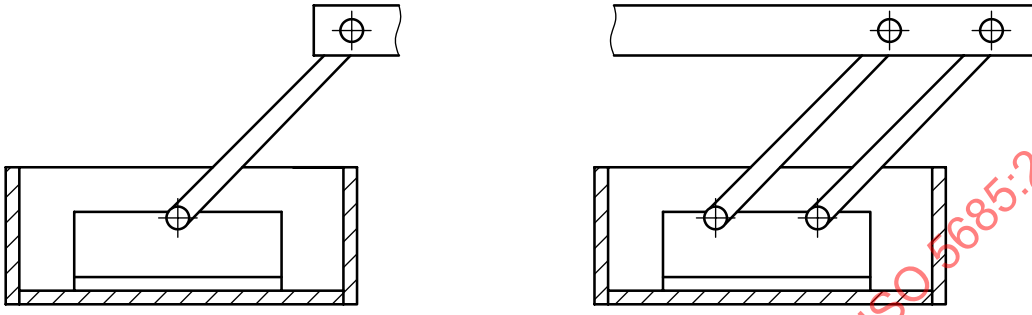
Figure 10 — Parallel positions of the specimen boxes with self-supporting arms extending from the centre

10.2.3 Switching the positions in the case of series orientation of the specimen boxes

In the case of series orientation, after the wiper bridge has been removed the positions of the two specimen boxes are to be swapped and rotated through 180° after 10 000 cycles [see Figure 11 a) to Figure 11 c)].

a) Top view before switching of the specimen box

b) Top view after switching of the specimen box



c) Lateral view: examples for wiper arms

Figure 11 — Positions of the specimen boxes in series with self-supporting arms extending to one side

10.3 Remounting the wiper bridge

All pivot joints are to be cleaned. The wiper bridge is then to be mounted on the abrasion testing device in the same direction as for the first 10 000 wiping cycles. Before the wiper bridge is inserted, the freedom of movement of the pivot joints of the wiper arms and holders is to be checked again.

10.4 Carrying out the second 10 000 wiping cycles

Set the wiping cycle counter on the abrasion testing device to 10 000 wiping cycles and start the abrasion testing device. After another 10 000 wiping cycles (i.e. a total of 20 000 wiping cycles), the abrasion testing device automatically switches off.

After this, the freedom of movement of the wiper pivot joints is to be checked again. If this movement is not free (e.g. due to test dust in the pivot joints), the entire 20 000 wiping cycles are to be repeated with a new test piece and a fresh suspension.

11 Cleaning and visual assessment of the test pieces

a) The test pieces are to be removed from the strips of adhesive tape in the specimen boxes and taken out of the boxes.

b) The test pieces are to be pre-cleaned under running water (with a hardness of less than 205 mg/l after evaporation), dried and then wiped with a soft cloth soaked with isopropyl alcohol. After this, they are to be rinsed off again with deionized water. To dry the test piece, carefully press it between two linen cloths or blow it dry with clean air or nitrogen.

c) 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.

d) Visible stripes due to non-uniform abrasion and/or chatter marks are evidence of a fault in the test set-up. A single faulty individual test (i.e. test of one test piece) may be repeated using a new test piece (see 3.2).

12 Measurement of final haze

Before the final haze is measured, the test pieces are to be conditioned for at least 24 h at (23 ± 2) °C and (50 ± 5) % relative humidity. The haze measurement is to be started within 5 min of removal of the test pieces from the conditioning environment.

The abrasion-treated test piece is to be held directly in front of the entrance port of the integrating sphere in such a way that the abraded side faces the entrance port. The scattered light (final haze) is to be measured at nine points in a defined area on the test piece (see 6.4.2).

The angle between the normal to the surface of the test piece and the axis of the light beam shall not exceed 8°.

The measured values are to be documented in a test record (see A.2 for an example).

A mean value of the test results is to be calculated for every test piece.

13 Evaluation and presentation of the results

The mean value of the initial haze is to be subtracted from the mean value of the final haze of every test piece, and this allows the light scattering to be calculated that results from the abrasion treatment of the test piece, also referred to as Δhaze.

14 Test report

The test report shall contain at least the following information:

a) name and address of the test laboratory;

b) date of the test;

c) all details that are necessary for the identification and characterization of the test piece, i.e. details of the material and, if applicable, coating (manufacturer, product designation, batch number, application procedure, drying and curing conditions etc.);

d) reference to this document (i.e. ISO 5685:2022);

e) type of sampling;

f) wiper rubber used;

g) type of illuminant used for the haze measurement (standard illuminant A or C);

h) mean haze value in % before and after the abrasion treatment, and delta haze;

i) every unusual observation (deviation) during the test;

j) every deviation from the test method specified in this document.

Annex A
(informative)

Sample templates

A.1 Drawing of a suitable wiper rubber holder

Figure A.1 shows a wiper rubber holder for CR wiper rubber/BOSCH, "H-Stoff P32", article no. 3.391.018.399; manufacturer: Robert Bosch GmbH, 77813 Bühl, Germany.

This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this (these) product(s).

Dimensions in millimetres

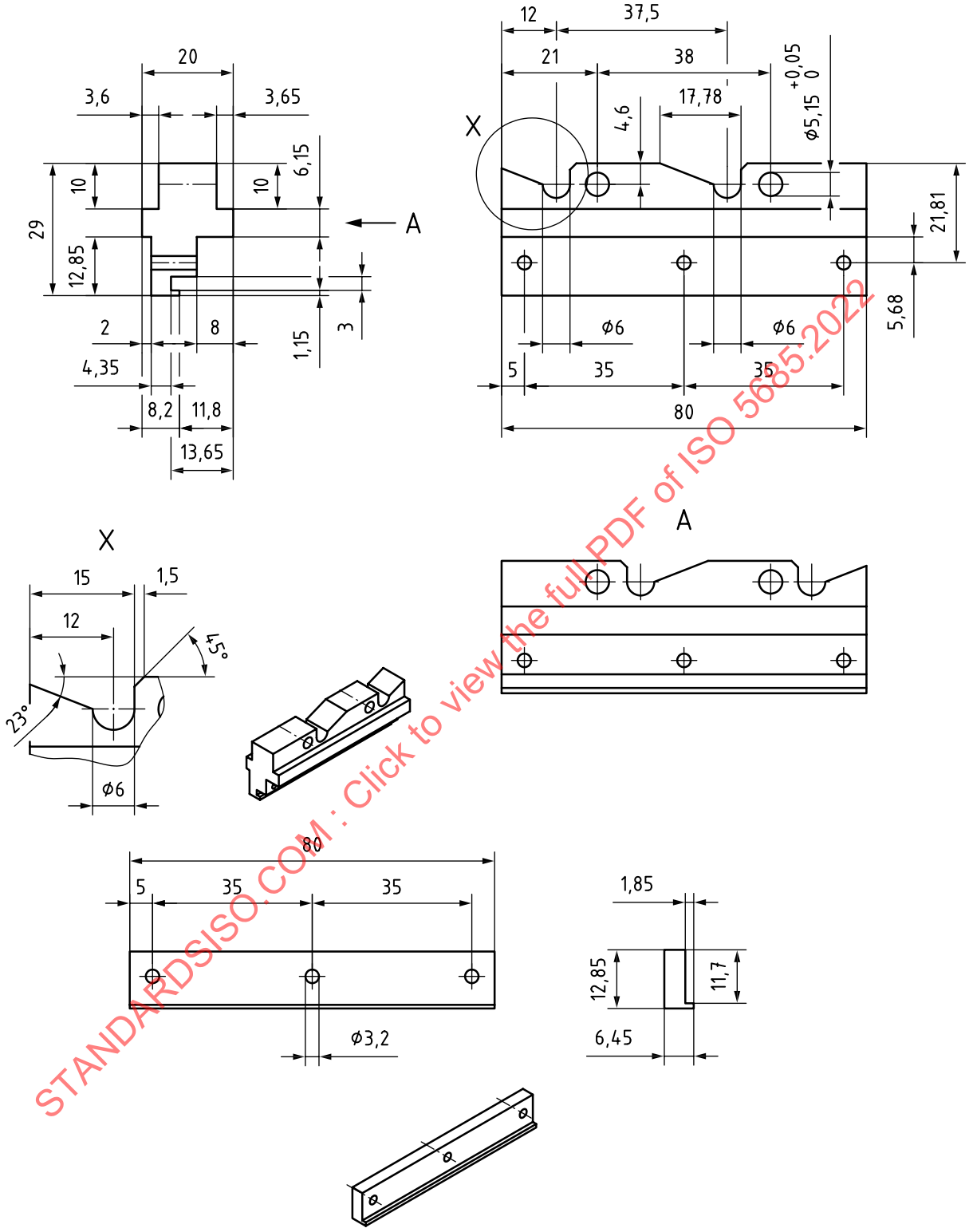


Figure A.1 — Drawing of the wiper rubber holder (see also Figure 5)

A.2 Recording form for the haze measurement (template)

Table A.1 and Table A.2 are examples of forms used to document the measured values of initial haze and final haze.

Table A.1 — Initial haze

No.	Internal Lab No.	Measuring point									Mean value	Standard deviation
		1	2	3	4	5	6	7	8	9		