United Nations ECE/TRANS/WP.29/2017/111

Economic and Social Council

Distr.: General
18 August 2017

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

173rd session
Geneva, 14-17 November 2017
Item 4.7.1 of the provisional agenda
1958 Agreement:
Consideration of draft amendments
to existing Regulations submitted by GRSG

Proposal for Supplement 6 to the 01 series of amendments to Regulation No. 43 (Safety glazing)

Submitted by the Working Party on General Safety Provisions*

The text reproduced below was adopted by the Working Party on General Safety Provisions (GRSG) at its 112th session (ECE/TRANS/WP.29/GRSG/91, paras. 11-12). It is mainly based on official documents ECE/TRANS/WP.29/GRSG/2017/6 and ECE/TRANS/WP.29/GRSG/2017/8. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration at their November 2017 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2016–2017 (ECE/TRANS/254, para. 159 and ECE/TRANS/2016/28/Add.1, cluster 3.1), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

Annex 3

Paragraphs 3.2.1. to 3.2.2.3., amend to read (keeping Figure 2.1 unchanged):

"3.2.1. Apparatus

……

…… The elastic properties of the phantom head on impact are determined by the hardness and the thickness of the intermediate ring (13) and the basin.

Instead of the data transmission via cables, wireless data transmission (e.g. radio transmission) may be used. In this case, it shall be ensured that those electronic components additionally installed in the headform do not influence mass, gravity centre point and spring force of the headform. Those electronic components shall be installed on the base plate (24) only. A mass correction, if necessary, is also restricted to the base plate at that surface which faces the hollow space within the headform. If additional miniature components for controlling of the electronic modules are required (e.g. micro switches, loading sockets for voltage supply), these may replace the co-axial cables. In this case the original holes in the cover plate (29) and the protective cap (30) have to be used for the installation and wiring.

……

List of pieces for the 10 kg headform of Figure 2.1

Position No.	*Number of pieces*	*Standard notation*	*Material*	*Remarks*
1	1	Magnetic holding device	Steel EN10025-2-E295GC	-
2	1	Vibration damper	Rubber / Steel	Diameter: 50 mm Thickness: 30 mm Thread: M10
3 [(a)]	4	HF connector BNC	-	Coupler-coupler (EN 122120)
4	1	Hexagonal nut ISO10511-M10-05	-	-
5	6	Disc ISO7090-6-200HV	-	-
6 [(a)]	3	Transition piece	-	-
7	6	Cylinder screw ISO4762-M6x140-8.8	-	Torque about 12 Nm
8	3	Hexagonal nut ISO10511-M8-05	-	Torque about 4 Nm (ref. paragraph 3.2.2.3.)
9	3	Disc	Steel EN10025-2-E295GC	Hole Diameter: 8 mm Outer Diameter: 35 mm Thickness: 1.5 mm
10	3	Rubber ring	Rubber, hardness 60 IRHD	Hole Diameter: 8 mm Outer Diameter: 30 mm Thickness: 10 mm
11	1	Damping ring	Gasket paper	Hole Diameter: 120 mm Outer Diameter: 199 mm Thickness: 0.5 mm
12	-	-	-	-
13	1	Intermediate ring	Butadiene-rubber, hardness about 60 IRHD	Hole Diameter: 129 mm Outer Diameter: 192 mm Thickness: about 6 mm

Position No.	*Number of pieces*	*Standard notation*	*Material*	*Remarks*
				(ref. paragraph 3.2.2.3.)
14	3	Guide tube	Polytetrafluoroethylene (PTFE)	Inner Diameter: 8 mm Outer Diameter: 10 mm Length: 40 mm
15	3	Hexagonal nut ISO10511-M8-05	-	-
16	3	Threaded bolt DIN 976-1-M8x90-B-8.8	-	-
17	3	Screwed insert	Cast alloy EN1982-CuZn39Pb1Al-C-GP	Dimensions M8x12 (DIN 7965)
18	1	Basin	Polyamide 12 (ISO 1874-1)	-
19	1	Cover	Butadiene-rubber	Thickness: 6 mm Rib on one side
20	1	Guide bush	Steel EN10025-2-E295GC	-
21	4	Counter sunk screw ISO2009-M5x10-5.8	-	-
22	1	Damping disc	Gasket paper	Diameter: 65 mm Thickness: 0.5 mm
23	-	-	-	-
24	1	Base plate	Steel EN10025-2-E295GC	-
25	1	Set screw with hexagonal socket	Class of strength 45H (ISO 898-5)	-
26	1	Tri-axial mounting block	-	-
27	3	Acceleration gauge	-	ref. paragraph 3.2.2.1.
28	1	Wood component	Hornbeam, glued in layers	-
29	1	Cover plate	Alloy EN573-3 ; EN AW-5019 (EN AW-AlMg5)	-
30	1	Protective cap	Polyamide 12 (ISO 1874-1)	-

Note [(a)]: These components are unnecessary in case of wireless data transmission. In this case, other components for data transmission are installed in the headform (e.g. radio transmitter), ref. para. 3.2.1.

3.2.2. Adjustment and calibration

…… the cross arm's fall is dampened and the phantom head falls onto the sample. If wireless data transmission is used instead of the data transmission via cables, the guide system can be omitted if there is no risk of obstruction of the free vertical drop by any cables.

No impulse may be given to the phantom head by the drop appliance or by the measuring cable (if applicable), so that it is accelerated only by gravity and falls vertically.

……

3.2.2.1. Measuring device which allows determining HIC-values with the headform described under paragraph 3.2.1., for recording and evaluation of the measured deceleration curves $a_x(t)$, $a_y(t)$ and $a_z(t)$, transmitted from the headform acceleration gauges via cables or wireless: acceleration gauges, measuring and recording instruments according to ISO 6487, channel-amplitude class CAC 5,000 m/s² and channel-frequency class CFC 1,000 Hz.

3.2.2.2. Equipment to calibrate the phantom head

…… small drop heights.

An impact plate which is made of steel is 600 mm x 600 mm in size and at least 50 mm thick. The impact surface shall be polished:

Surface roughness average $R_a < 0.5$ µm, flatness tolerance t = 0.05 mm.

3.2.2.3. Calibration and adjustment of the phantom head

……

The impact plate shall be clean and dry and during the test shall lie non-positively on a concrete base. Alternatively, the impact plate may be placed in a massive supporting device if this device is connected to a concrete foundation.

……

The greatest deceleration a_z from the various drop heights on the z-axis shall lie within the limits given in the table:

Drop height mm	*Greatest deceleration a_z as a multiple of acceleration due to gravity g*
50	82 ± 8
100	128 ± 8
150	167 ± 10
254	227 ± 14

The deceleration curves should be based on a unimodal vibration. The deceleration curve of the drop height of 254 mm shall run at least 1.5 ms and at most 2 ms over 100 g.

……"

Insert new paragraphs 3.2.3.1. and 3.2.3.2., to read:

"3.2.3.1. For testing flat test pieces, the support is as described in paragraph 3.1.3. but with the modification that the rubber gaskets shall be 50 mm +1/-0 mm wide (instead of 15 mm ± 1 mm), covering the borders of the two steel frames completely. The minimum recommended torque for M20 bolts is 30 Nm. Alternatively, other pressing techniques may be used, e.g. hydraulic or pneumatic pressing.

3.2.3.2. For testing complete glazing, the support shall consist of a rigid piece corresponding to the shape of the pane so that the headform weight faces the internal surface. The pane shall be clamped to the supporting structure by means of appropriate devices, with interposed stripes of rubber of hardness 70 IRHD and thickness of about 3 mm, the width of contact over the whole perimeter being about 15 mm."

Paragraph 3.2.5., amend to read:

"3.2.5. Test procedure

The flat test piece or the complete glazing shall be clamped to the supporting structure according to paragraph 3.2.3.1. respectively 3.2.3.2. 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 surface of the test piece or glazing shall be substantially perpendicular to the incident direction of the headform weight. The headform weight shall strike the test piece or glazing at a point within 40 mm of its geometric centre on that face which represents the inward face of the plastic glazing when the latter is mounted on the vehicle, and shall be allowed to make only one impact.

The deceleration curves occurring on impact on the sample for a_x, a_y and a_z should be recorded according to time t.

…… The acceleration components a_x and a_y should be smaller for vertical impact than 0.1 a_z."

Paragraph 3.2.6., amend to read (also replacing equation (2)):

"3.2.6. Evaluation

……

(1) $$a_{res}(t) = \left(a_x^2(t) + a_y^2(t) + a_z^2(t)\right)^{1/2}$$

The HIC-value should be calculated as a measurement of the danger of blunt skull-brain-injuries using the following equation (2):

(2) $$HIC = \max\ f(t) = \max_{t_1,t_2}\left[\left(t_2 - t_1\right)^{-1.5}\left(\int_{t_1}^{t_2} a_{res}(t)dt\right)^{2.5}\right]$$

The integral limits t_1 and t_2 should be selected in such a way that the function f(t) takes a maximal value."

Paragraph 4.1., amend to read:

"4.1. Taber test apparatus"

Paragraphs 4.1.1. to 4.1.2., amend to read (renumbering Figure 4 to 4.1 and inserting a new Figure 4.2):

"4.1.1. Abrading instrument[1], shown diagrammatically in Figures 4.1 and 4.2 and consisting of:

(a) A horizontal turntable, with centre clamp, which revolves counter-clockwise at a fixed speed of 60 ± 2 rev/min or 72 ± 2 rev/min;

(b) 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 distance between the internal faces of the wheels shall be 52.4 mm ± 1.0 mm (which corresponds to a distance between the symmetry planes of the wheels of 65.1 mm). The horizontal offset of a virtual line, which runs through both wheel axes, from the turntable axis shall be 19.05 mm ± 0.30 mm;

(c) A vacuum suction system (not depicted in Figures 4.1 and 4.2) 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.

[1] A suitable abrading instrument is supplied by Taber Industries (United States of America).

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 placed evenly on the test piece in their full width. When they are in contact with the rotating test piece they rotate in opposite directions so as to exert, twice during each rotation of the test piece, a compressive and abrasive action along curved lines over an annular area of about 30 cm^2.

Figure 4.1
Diagram of abrading instrument

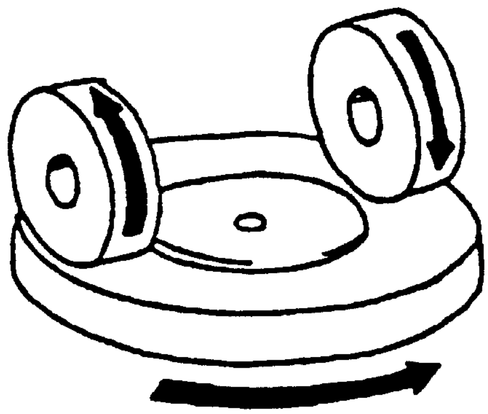
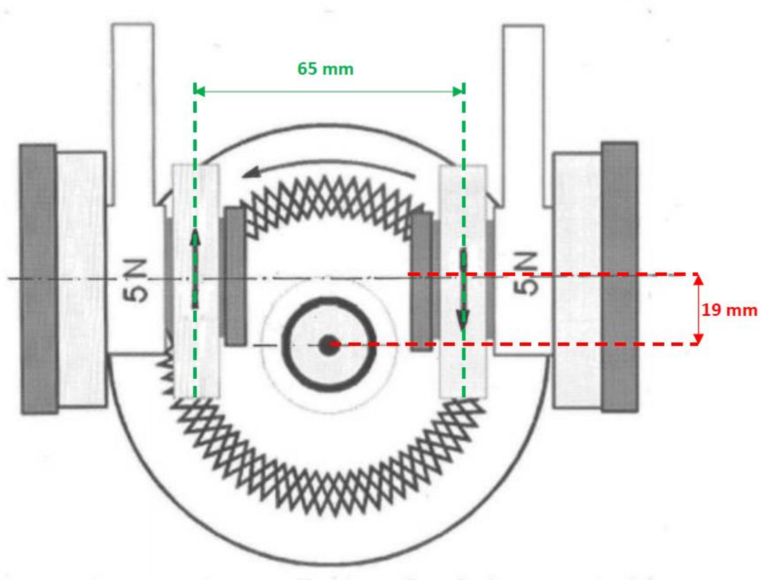


Figure 4.2
Diagrammatical top view of abrading instrument

Effective weight of wheels on test piece, distance between wheel symmetry planes and offset between wheel and turntable axes are indicated (values rounded to integers).



4.1.2. 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 µm and 102 µm and uniform distribution throughout the resilient binder. Each wheel shall be molded 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."

Insert new paragraphs 4.1.2.1. to 4.1.2.3., to read:

"4.1.2.1. Testing of glass

The abrasive wheel shall be such that the light scatter resulting from abrading (final haze minus initial haze, ref. paragraph 4.5.1.) of each of three float glass samples subjected to 1,000 cycles of abrasion is within 0.7 per cent ± 0.5 per cent. The float glass shall be 3 mm to 4 mm in thickness and of at least 70 per cent luminance transmittance. Abrasion should be conducted on the upper glass side (air or fire side).

4.1.2.2. Testing of plastic materials

The abrasive wheel shall be such that the light scatter resulting from abrading (final haze minus initial haze, ref. paragraph 4.5.1.) of each of three AS4000S[3] hard-coated polycarbonate samples subjected to abrasion is within the qualification ranges[4] of 0 per cent to 2.6 per cent after 100 cycles, 0.5 per cent to 6.3 per cent after 500 cycles and 1.0 per cent to 7.4 per cent after 1,000 cycles.

The AS4000S hard-coated polycarbonate samples shall be free of any inhomogeneity in the surface when examined with a human eye and have a luminous transmittance of at least 70 per cent and a primer coating thickness of 0.5 µm to 1.5 µm and topcoat coating thickness of 4.5 µm to 8.5 µm after thermal curing for 30 minutes at 130 °C. The AS4000S reference hard-coated samples shall be supplied with a certificate of analysis of manufacturing quality for coating thicknesses, cure time and cure temperature. An alternative reference hard-coated polycarbonate sample can be used, provided a correlation has been developed against the standardized AS4000S hard-coated polycarbonate reference samples. Any proposed alternative hard-coated polycarbonate sample shall meet the same qualification requirements as the reference AS4000S hard-coated polycarbonate sample.

The wheels are qualified if all measured haze values for the three AS4000S hard-coated polycarbonate reference samples per cycles number, and for each

[2] Suitable abrasive wheels may be obtained from Taber Industries (United States of America), type Calibrase CS-10F.

[3] Hard-coating polysiloxane type AS4000S (AS4000 type coating adjusted to flow coating of large sheets) by Momentive Performance Materials (Germany).

[4] The qualification ranges have widths of (4 x s_R), where s_R is the reproducibility standard deviation determined in a round robin test (conducted by Technical Committee ISO/TC22/SC11 in year 2013) for each cycles number and the above mentioned factor represents the probability of P = 95 per cent.

of the three cycles numbers[5], are within the qualification ranges. Only if this requirement is fulfilled, the test will be proceeded using these wheels. The average of the measured values for the three AS4000S hard-coated polycarbonate reference samples per cycles number is used to calculate a correction factor per cycles number for exactly this wheel pair (ref. paragraph 4.5.2.2.). This correction factor is used to correct the measured values obtained when testing a test piece with this wheel pair.

4.1.2.3. Standardization of abrading wheels

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.

In case a new refacing stone is used during the life time of a qualified wheel pair, a new qualification as described in paragraphs 4.1.2.1. respectively 4.1.2.2. shall be performed, and (for testing of plastic materials only) the correction factor shall be redetermined for that wheel pair.

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. Affix the load[6] corresponding to a total load of 500 g (per wheel) to the abraser. Visually inspect the fine side of the Taber ST-11 refacing stone and only use it if no contaminations are visible. Mount the visually checked Taber ST-11 refacing stone (or equivalent) on the turntable, fine side up, and secure using the nut.

Lower the vacuum nozzle and adjust the height to 1 mm above the refacing stone 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 mbar) 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 to 5×10^{-4} Ω/cm.

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).

[5] The wheel qualification shall be carried out for each of the three cycles numbers (100, 500 and 1,000) regardless of whether it might be intended to use the wheel pair on test pieces at selected cycle numbers only.

[6] In case of a Taber abraser, the accessory mass for a total load of 500 g shall weigh 250 g ± 1 g.

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 minutes."

Paragraph 4.1.3., amend to read:

"4.1.3. Hazemeter[7], shown diagrammatically in Figure 5.1 and consisting of:"

Insert new paragraphs 4.1.3.1. and 4.1.3.2., to read:

"4.1.3.1. A light source of colour temperature 2,856 K ± 50 K and a photodetector, and the combination shall be filtered to provide an output corresponding to the luminosity response of the 1931 CIE Standard Colorimetric Observer with CIE Standard Illuminant A. The output shall be proportional to within 1 per cent 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.

4.1.3.2. 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 per cent 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°)."

Paragraphs 4.1.4. and 4.1.5., amend to read (also replacing Figure 5.1):

"4.1.4. 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°).

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.

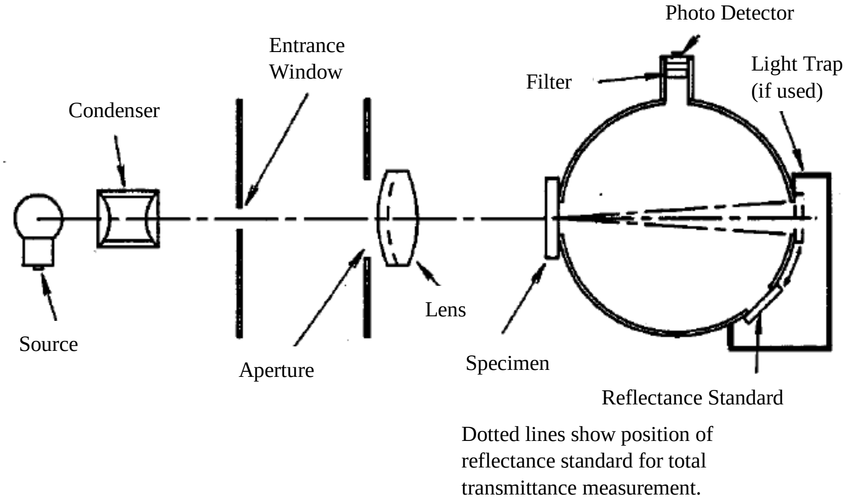
[7] A suitable instrument for measuring haze is supplied by BYK-Gardner (Germany).

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.

Figure 5.1
Hazemeter



4.1.5. Test piece holder

A suitable holder shall be used to permit positioning the test piece on the hazemeter so that the light beam is centred in the abradant 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."

Paragraph 4.2., amend to read:

"4.2. Test conditions

Temperature: 23 °C ± 2 °C

Pressure: 860 to 1,060 mbar

Relative humidity: 50 ± 5 per cent."

Paragraphs 4.4.1. to 4.4.3., amend to read:

"4.4.1. 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 demineralized 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.

4.4.2. Conditioning

Condition the test pieces for a minimum time of 48 hours at 23 °C ± 2 °C and 50 ± 5 per cent relative humidity. Begin the testing within 5 minutes after removal from conditioning.

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

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

Take four readings as indicated in the following table:

……

Calculate the total transmittance $T_t = T_2/T_1$.

Calculate the diffuse transmittance T_d as follows:

$$T_d = \frac{T_4 - T_3(T_2/T_1)}{T_1 - T_3}$$

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

Haze, or light scattered, = $\frac{T_d}{T_t} \times 100\ \%$

Measure the initial haze of the test piece at a minimum of four equally-spaced points along the unabraded track in accordance with the formula above. Average the results for each test piece. In lieu of the four measurements, an average value may be obtained by rotating the piece uniformly at 3 rev/sec or more."

Insert new paragraphs 4.4.4. to 4.4.6., to read (inserting also new Figure 5.2):

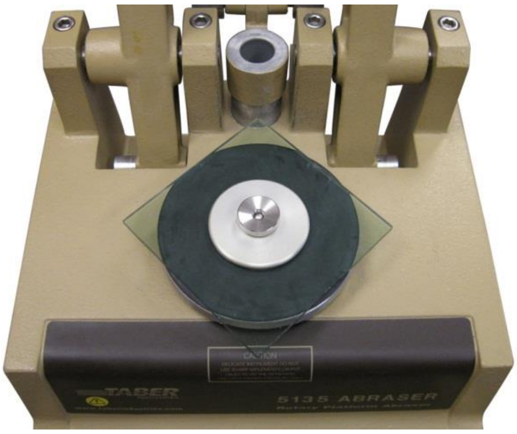
"4.4.4. Abrasion

For each type of safety glazing, carry out three tests with the same load. Use the haze as a measure of the subsurface abrasion, after the test piece has been subjected to the abrasion test.

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 5.2. Secure using the clamp plate and nut. Affix the load corresponding to a total load of 500 g (per wheel) 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 vacuum suction force so that a residual pressure of 13.7 kPa (137 mbar) or lower results. Lower the arms so the wheels contact the surface of the test piece. Set the counter to zero and programme the appropriate number of cycles. Start the abraser and subject the test piece to abrasion for the selected number of cycles.

Figure 5.2
Abraser turntable with test piece mounted at 45° from machine front



4.4.5. Cleaning after abrasion

After the abrasion test is done, 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 paragraph 4.4.1.

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

4.4.6. 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 the formulas of paragraph 4.4.3. If the abrasion track is not homogeneous, up to 16 equally spaced points along the track may 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 may be obtained by rotating the piece uniformly at 3 rev/sec or more."

Paragraph 4.5., amend to read:

"4.5. Expression of results"

Insert new paragraphs 4.5.1., 4.5.2., 4.5.2.1. and 4.5.2.2., to read:

"4.5.1. General

Subtract the average initial haze from the average final haze, the difference representing the light scatter resulting from abrading the test piece also called Δ haze.

4.5.2. Correction calculation, for testing of plastic materials only

The measured Δ haze value shall be corrected using a correction factor based on the value which has been determined for the AS4000S hard-coated polycarbonate reference samples by testing with the same wheel pair (ref. paragraph 4.1.2.2.).

4.5.2.1. Calculate the corrected delta haze value as follows:

$\Delta haze_c(r) = \Delta haze_m(r) \times X_c(r)$

Where:

$\Delta haze_c(r)$ is the corrected delta haze value of a test piece at a certain cycle number r,

$\Delta haze_m(r)$ is the delta haze value obtained by subtracting measured initial haze from measured final haze of the test piece at a certain cycle number r,

$X_c(r)$ is the correction factor of the wheel pair used to test the above-mentioned test piece at the same cycle number r, as determined according to paragraph 4.5.2.2.

4.5.2.2. The correction factor[8] is determined twice during the lifetime of its wheel pair, at the beginning (at a wheel diameter of approximately 52 mm) and after half of its life time (at a wheel diameter of 48 mm). At the beginning, no

[8] It is sufficient to determine the correction factors of a wheel pair only for those of the three cycles numbers (100, 500 and 1,000) which have actually been selected for testing of test pieces.

additional measurement is necessary since the data of the wheel qualification can be used to calculate the correction factor as described below.

If a new refacing stone is used during the life time of that wheel pair, the correction factor shall be determined once more, provided that wheel pair has passed a new qualification.

Calculate the correction factor for a certain wheel pair according to:

$X_c(r) = \Delta haze_{rv}(r) / \Delta haze_{av}(r)$

Where:

$\Delta haze_{rv}(r)$ is the delta haze reference value[9] of the AS4000S hard-coated polycarbonate reference samples at a certain cycle number r:

100 cycles: $\Delta haze_{rv}(100)$ = 1.1 per cent,

500 cycles: $\Delta haze_{rv}(500)$ = 2.8 per cent,

1,000 cycles: $\Delta haze_{rv}(1,000)$ = 3.7 per cent.

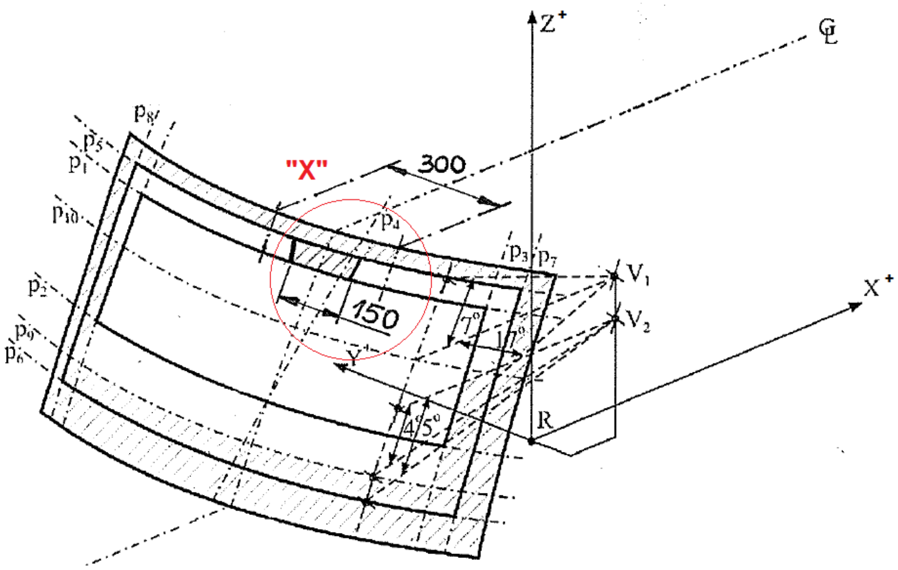
$\Delta haze_{av}(r)$ is the actual delta haze value of the AS4000S hard-coated polycarbonate reference samples at a certain cycle number r. This value is the mean value actually determined for the respective wheel pair by testing three reference samples at that cycle number with this wheel pair (ref. paragraph 4.1.2.2.)."

[9] These fixed $\Delta haze_{rv}(r)$ values for the AS4000S hard-coated polycarbonate reference samples are the mean values per cycles number obtained in the round robin test by those participating test labs which proved to use qualified wheels according to paragraph 4.1.2.2.

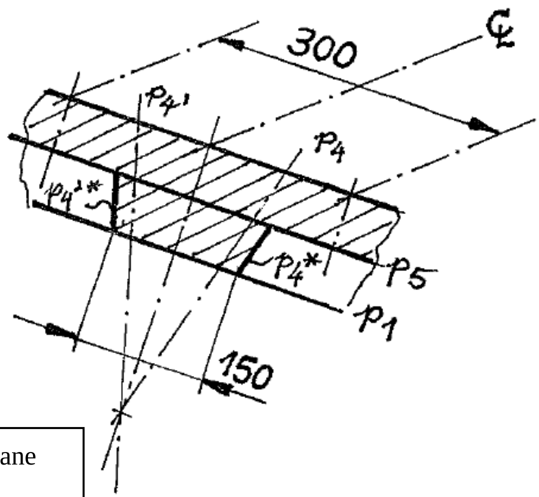
Annex 21, Figure 2a, amend to read:

"Figure 2a:

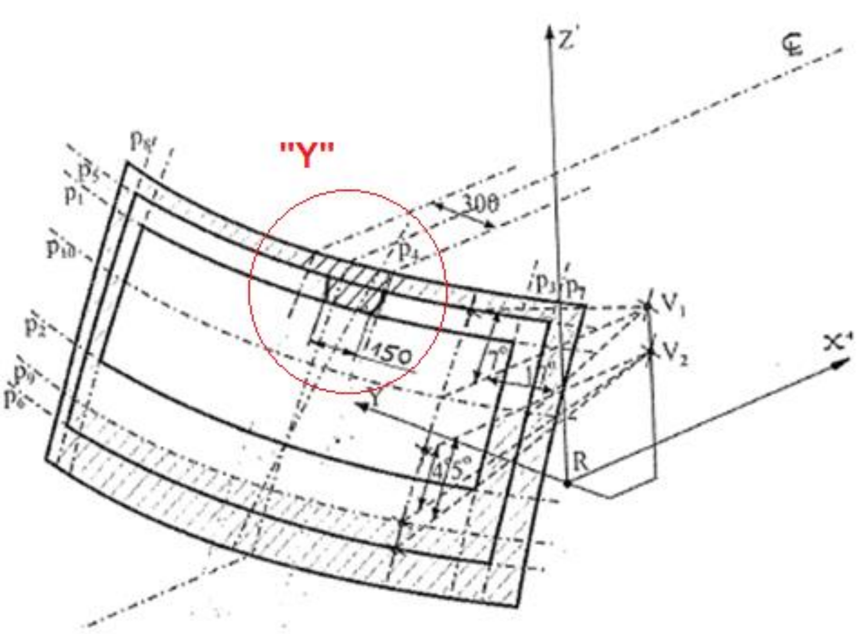
Reduced test area "B" (example of a left-hand steering control vehicle) - upper obscuration area as defined in paragraph 2.4.2.2.



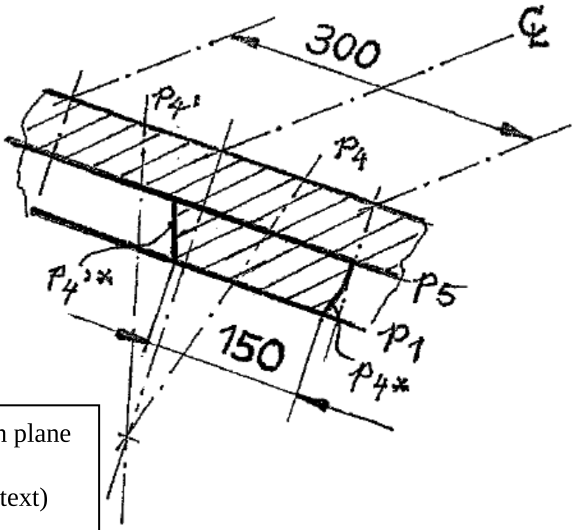
Detail "X": example symmetric to C_L



C_L : trace of the longitudinal median plane of the vehicle
p_i : trace of the relevant plane (see text)
p_4 // p_4*; p_4' // p_4'*



Detail "Y": example asymmetric to C_L



C_L : trace of the longitudinal median plane of the vehicle
p_i : trace of the relevant plane (see text)
p_4 // p_4*; p_4' // p_4'*

"