

25 Safety Glass

Refer to: R43 00-S10/C1

25.1 Effective date and Scope:

- 25.1.1 As for the category M2 and M3, the new vehicle types from 2006/7/1 and all vehicle types as of 2008/7/1, the safety glass (except for the dashboard) equipped within the sitting area of all these mentioned vehicles, shall comply with this regulation.
- 25.1.2 As for the category M1 and N, the new vehicle types as of 2006/7/1 and all vehicle types as of 2008/7/1, the frontal windscreens, shall comply with the safety glass requirement of "Thickness test", "227 g ball test", "2260 g ball test", "Headform test" and "Light Transmission test" regulated in this regulation.
- 25.1.3 As for the category symbols M1 and N, the new vehicle types as of 2008/1/1 and all vehicle types as of 2010/1/1, the safety glass (except for the dashboard) equipped within the sitting area of vehicle, shall comply with this regulation.
- 25.1.4 The applicants applying for low volume safety approval or vehicle-by-vehicle low volume safety approval may be exempt from regulation of "safety glass" except for large passenger vehicle and child-only vehicle.

25.2 The safety glass panes shall be subjected to the tests listed in the following table:

Tests	Scope	Windscreen	Glass panes other than windscreens	
		Laminated glass (L)	Toughened glass (T)	Laminated glass (L)
Thickness test		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fragmentation test		---	<input type="checkbox"/>	---
227 g ball test		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2260 g ball test		<input type="checkbox"/>	---	---
Headform test		<input type="checkbox"/>	---	<input type="checkbox"/>
Test of resistance to abrasion		<input type="checkbox"/>	---	<input type="checkbox"/>
Test of resistance to high temperature		<input type="checkbox"/>	---	<input type="checkbox"/>
Resistance-to-radiation test		<input type="checkbox"/>	---	<input type="checkbox"/>
Resistance-to-humidity test		<input type="checkbox"/>	---	<input type="checkbox"/>

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Light-transmission test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Optical-distortion test	<input type="checkbox"/>	---	---
Secondary-image-separation test	<input type="checkbox"/>	---	---
Identification-of-colours test	<input type="checkbox"/>	---	---

25.3 Safety Glass shall according to suitable types and range of principle are as below :

25.3.1 Trade name

25.3.2 Category of glass (toughened-glass/laminated-glass)

25.3.3 Nominal thickness

25.4 Thickness test: for the laminated-glass pane, the nominal thickness can bear a tolerance of ± 0.2 (n) mm, where n is the number of layers of glass. For the toughened-glass pane, the tolerance of can reach ± 0.2 mm.

25.5 Fragmentation test:

25.5.1 Number of samples: By using the complete products, four samples per set (totally 2 sets) in the case of flat glass panes, or five samples per set (totally 3 sets) in the case of flat and curved glass panes.

25.5.2 A hammer of about 75 g or some other appliance giving equivalent results shall be used. The radius of curvature of the point shall be 0.2 +/- 0.05 mm. The fragmentation test should be held compliant with the following regulations:

25.5.2.1 The number of fragments in any 5cm x 5 cm square is not less than 40 or more than 400, or in the case of glazing not more than 3.5 mm thick, 450. A fragment extending across a side of a square shall count as half a fragment.

25.5.2.2 Fragmentation shall not be checked in a strip 20 mm wide round the edge of the samples, this strip representing the frame of the glass; nor within a radius of 75 mm from the point of impact. Fragments of an area exceeding 3 cm² shall not be allowed.

25.5.2.3 A few fragments of elongated shape shall be allowed, provided that: their ends are not knife-edged, if they extend to the edge of the glass pane they do not form an angle of more than 45 degrees with it, and if, except in the case provided for in paragraph 25.5.2.4 below, their length does not exceed 75 mm.

25.5.2.4 When one test among all those carried out using the points of impact prescribed has given an unsatisfactory result, taking account of deviations, which do not exceed the following limits:

Not more than 5 fragments between 60 and 75 mm long, not more than 4 fragments between 75 and 100 mm long, and is repeated on a new test piece which either conforms to the requirements of paragraph 25.5.2.1, 25.5.2.2 and 25.5.2.3 or presents deviations within the above specified limits.

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25.5.2.5 When two tests among all the tests carried out using the points of impact prescribed in paragraph above has given an unsatisfactory result, a further series of tests carried out on a new set of samples conforms to the prescriptions of not more than two samples of the new set present deviations within the above specified limits of paragraph 25.5.2.4.

25.6 227 g ball test:

25.6.1 Test piece: The test piece shall be a flat square of side $300 \pm 10/0$ mm

25.6.2 Condition the test piece at 20 ± 5 °C for at least four hours immediately preceding the test. The test is processed using a hardened-steel ball with a mass of 227 ± 2 g and a diameter of approximately 38mm, and dropping the ball freely from a height specified in the following table or giving the ball a velocity equivalent to that obtained by the free fall. 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 that face of the test piece, which represents the outside face of the safety-glazing pane when mounted on the vehicle.

25.6.2.1 The test conditions of laminated-glass pane are tabulated as below:

Scope	Amount of Tested Specimens/ Permitted first tested of un-satisfactory result	Height of fall(m) Nominal thickness e (mm)	Temperature (°C)		
			40±2	-20±2	23±2
Windscreen	10 / 2	$e \leq 4.5$	9	8.5	-
		$4.5 < e \leq 5.5$	10	9	
		$5.5 < e \leq 6.5$	11	9.5	
		$6.5 < e$	12	10	
Glass panes other than windscreen	4 / 2	$e \leq 5.5$	-	-	5
		$5.5 < e \leq 6.5$			6
		$6.5 < e$			7

25.6.2.2 A satisfactory result for laminated-glass pane: the ball does not pass through the test piece and the test piece does not break into several pieces. If the interlayer is not torn, the weight of fragments detached from the side of the glass opposite to the point of impact must not exceed the appropriate values specified in the table below:

Scope	Nominal thickness e (mm)	Maximum permitted mass of the fragments, (g)
windscreen	$e \leq 4.5$	12
	$4.5 < e \leq 5.5$	15
	$5.5 < e \leq 6.5$	20

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	6.5 < e	25
Glass panes other than windscreen		15

More than the Permitted No of unsatisfactory result at each test temperature having given an unsatisfactory result, a further series of tests carried out on a new set of test pieces gives satisfactory results.

25.6.2.3 Six test pieces shall be subjected to testing for each thickness category, and the test condition is tabulated as follows:

Type	Nominal thickness e (mm)	Height of drop (m)
Toughened-glass pane	e ≤ 3.5	2
	e > 3.5	2.5

25.6.2.4 The test shall be deemed to have given a satisfactory result if the test piece does not break. When two tests having given unsatisfactory results, a further series of tests carried out on a new set of six test pieces give satisfactory results.

25.7 2260 g ball test:

25.7.1 Six square test pieces of 300mm±10/-0 side shall be subjected to testing.

25.7.2 Condition the test piece at 20 ± 5°C for at least four hours immediately preceding the test.

25.7.3 The test is processed using a hardened-steel ball mass of 2260 +/- 20 g and a diameter of approximately 82mm, and dropping the ball freely from a height of 4m or giving the ball a velocity equivalent to that obtained by the free ball. The point of impact shall be within 25mm of the geometric centre of the test piece. The ball shall strike that face of the test piece which represents the inward face of the safety-glass pane when the latter is mounted on the vehicle.

25.7.4 The test shall be deemed to have given a satisfactory result if the ball does not pass through the glazing within five seconds after the moment of impact.

25.7.5 One test having given an unsatisfactory result, a further series of tests carried out on a new set of test pieces gives satisfactory results.

25.8 Headform test:

25.8.1 In the case of windscreen, four samples of complete windscreen or six flat test pieces shall be tested. In the case of glass panes other than windscreen, six flat test pieces measuring (1,100 mm x 500 mm) +5/-2 (5/2) shall be subjected testing.

25.8.2 The flat test piece shall be kept at a constant temperature of 20 ± 5°C for at least four hours immediately preceding the test.

25.8.3 The total mass of the headform shall be 10 (±0.2) kg, and dropping the ball freely from a height of 1.5m (4m for the flat test piece of windscreen) or giving the ball a velocity equivalent to that obtained by the free ball. The weight shall strike the test piece within 40mm of the geometric centre on that face which represents the inward face of the safety-glass pane when the latter is mounted on the vehicle.

25.8.4 In the case of complete sample, this test shall be deemed to have given a satisfactory result if the following conditions are fulfilled:

- 25.8.4.1 The sample breaks displaying numerous circular cracks centred approximately on the point of impact, the cracks nearest to the point of impact being not more than 80 mm from it;
- 25.8.4.2 The layers of glass shall remain adhering to the plastics-material interlayer. One or more partial separation from the interlayer with a distance of less than 4 mm in breadth, on either side of the crack, is permitted outside a circle of 60 mm in diameter centred on the point of impact.
- 25.8.4.3 On the impact side: The interlayer must not be laid bare over an area of more than 20 cm².
- 25.8.4.4 A tear in the interlayer up to a length of 35 mm is allowed.
- 25.8.5 In the case of test pieces, this test shall be deemed to have given a satisfactory result if the following conditions are met:
 - 25.8.5.1 The test piece yields and breaks, displaying numerous circular cracks centred approximately on the point of impact,
 - 25.8.5.2 Tears in the interlayer are allowed, but the manikin's head must not pass through,
 - 25.8.5.3 No large fragments of glass shall become detached from the interlayer.
- 25.8.6 One test having given an unsatisfactory result, a further series of tests carried out on a new set of test pieces gives satisfactory results.

25.9 Test of resistance to abrasion:

- 25.9.1 Test pieces: three pieces of squares of side 100 mm.
- 25.9.2 Condition the test pieces for a minimum time of 48 hours at 20 +/- 5 degrees C and 60 +/- 20 per cent relative humidity.
- 25.9.3 The abrasion test shall be carried out on that surface of the test piece which represents the outside face of the laminated-glass pane when the latter is mounted on the vehicle. Abrading instrument consists of a horizontal turntable, which revolves counter-clockwise at 65 to 75 rev/min, and two weighted parallel arms each carrying a special abrasive wheel freely rotating; each wheel rests on the test specimen under the pressure exerted by a mass of 500 g, the test being continued for 1000 cycles. and measure the haze once again.
- 25.9.4 The wheels shall have a hardness of 72 ± 5 IRHD (International Rubber Hardness).
- 25.9.5 The light scatter as a result of abrasion of the test piece does not exceed 2%.
- 25.9.6 All test pieces shall conform to the requirements defined above.

25.10 Test of resistance to high temperature:

- 25.10.1 Test pieces: three samples or three square test pieces of at least 300 x 300 mm.
- 25.10.2 Heat test pieces to 100°C. Maintain this temperature for a period of two hours, then allow the test pieces to cool to room temperature.
- 25.10.3 The test for resistance to high temperature shall be considered to give a positive result if bubbles or other defects are not formed more than 15 mm from an uncut edge or 25 mm from a cut edge of the test piece or sample or more than 10 mm away of any

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cracks which may occur during the test.

- 25.10.4 One test having given an unsatisfactory result, a further series of tests carried out on a new set of test pieces or samples gives satisfactory results.

25.11 Resistance-to-radiation test:

- 25.11.1 Test pieces: three test pieces, with size of 76 mm x 300 mm.
- 25.11.2 Maintain the temperature of the test pieces at $45 \pm 5^{\circ}\text{C}$ throughout the test. That face of each test piece which would constitute a glazed exterior part of the vehicle shall face the lamp. place the test pieces in the test apparatus 230 mm from and parallel lengthwise to the lamp axis (750 \pm 50 W quartz mercury lamp or equivalent one) and the exposure time to UV shall be 100 hours.
- 25.11.3 The total light transmittance does not fall below 95 % of the original value before irradiation and in any event does not fall below 70 % (70 % for the windscreens).
- 25.11.4 The test piece or sample may however show a slight coloration after irradiation when examined against a white background, but no other defect may be apparent.
- 25.11.5 One test having given an unsatisfactory result, a further series of tests carried out on a new set of test pieces or samples gives satisfactory results.

25.12 Resistance-to-humidity test:

- 25.12.1 Test pieces: Three square test pieces of at least 300 x 300 mm.
- 25.12.2 Keep test pieces in a vertical position for two weeks in a closed container in which the temperature is maintained at 50 \pm 2 $^{\circ}\text{C}$ and the relative humidity at 95 \pm 4%.
- 25.12.3 Safety glazing shall be deemed to be satisfactory from the point of view of resistance to humidity if no significant change is observed more than 10 mm from the uncut edges and more than 15 mm from the cut edges after ordinary and treated laminated glass panes have been maintained for two hours in the ambient atmosphere.
- 25.12.4 One test having given an unsatisfactory result, a further series of tests carried out on a new set of samples gives satisfactory results.

25.13 Light-transmission test

- 25.13.1 Test piece: One test piece for the complete product. For the laminated-glass windscreen of M1 vehicles, the test shall be carried out in test area B (see Fig 2, 3); for the laminated -glass windscreen of M2, M3 and N vehicles, the test shall be carried out in the Zone I (see Fig 5). For the glass panes other than windscreen, the test piece of laminated-glass pane and the test piece of toughened -glass pane are both cut from the complete products.
- 25.13.2 The sensitivity of the measuring system shall be adjusted in such a way that the instrument indicating the response of the receiver

indicates 100 divisions when the safety-glass pane is not inserted in the light path. Insert the safety-glass pane between the diaphragm and the receiver and adjust its orientation in such a way that the angle of incidence of the light beam is equal to 0 ± 5 degrees. The regular transmittance should be measured on the safety-glass pane and for every point measured the number of divisions, n , shown on the indicating instrument, shall be read.

- 25.13.3 The regular transmittance ζ is equal to $n/100$. Before 2010/1/1, the regular transmittance measured in the case of windscreens shall not be less than 75 % and, in the case of windows other than windscreens shall not be less than 70 %. From 2010/1/1, in the case of windscreens or windows other than windscreens shall not be less than 70 %. In the case of glass panes in places not essential for the driver's vision (e.g. sun roofs) the regular light transmittance of the glass pane may be less than 70 %. Glass panes with a regular light transmittance less than 70 % shall be appropriately marked.

25.14 Optical distortion test

- 25.14.1 Test pieces: four samples (complete product) shall be submitted for testing.
- 25.14.2 The windscreen shall be mounted at the same angle of inclination as on the vehicle, at a distance of 4 m from the light source, and measure the angular deviation δ measured between two points M and M' on the surface of the glass pane, on the display screen 6-8 m away from the light source, see figure 6.
- 25.14.3 The maximum value of optical distortion:
- 25.14.3.1 For vehicle symbol category M1 in the extended test area A (an area extended to the median plane of the vehicle, as indicated in Fig 1, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle): 2' of arc.
- 25.14.3.2 For vehicle symbol category M1 in the reduced test area B (see Fig 2 and 3): 6' of arc.
- 25.14.3.3 For vehicles of categories M and N other than M1, in zone I (see Fig 5): 2' of arc.

25.15 Secondary-image-separation test

- 25.15.1
- 25.15.2 Test pieces: four complete samples shall be submitted for testing.
- 25.15.3 The distance between the test piece and the light box is more than 7 m. Mount the test piece at the specified rake angle. Determine whether the secondary image of the spots shifts beyond the point of tangency with the inside edge of the circle..
- 25.15.4 The maximum values of the separation of the primary and secondary images:
- 25.15.4.1 For vehicle symbol category M1 in the extended test area A (an area extended to the median plane of the vehicle, as indicated in Fig 1, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle): 15' of arc.
- 25.15.4.2 For vehicle symbol category M1 in the reduced test area B (see Fig 2 and 3): 25' of arc.

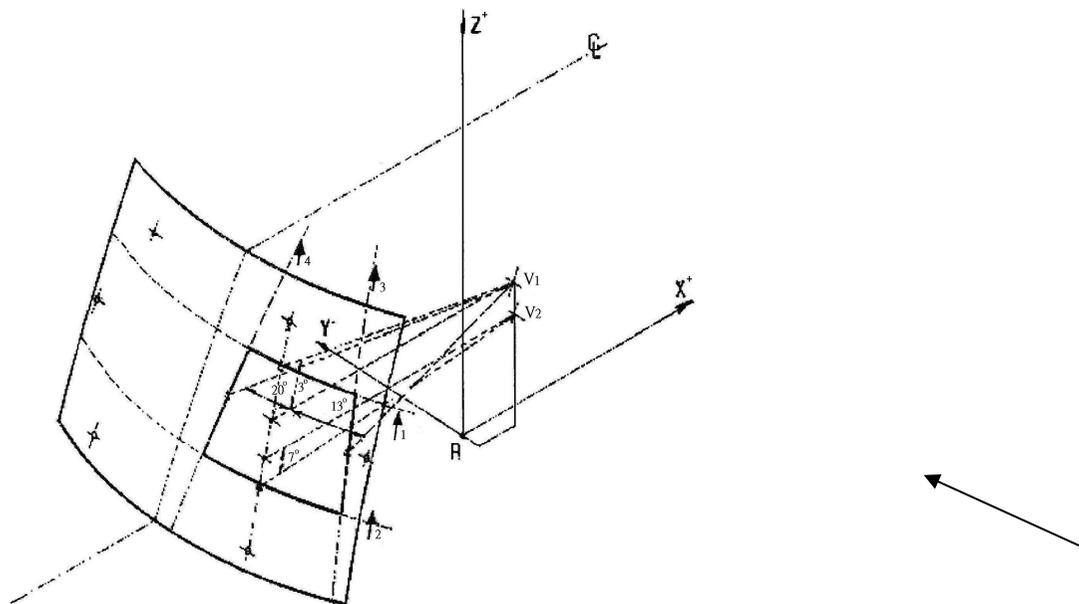
25.15.4.3 For vehicles of categories M and N other than M1, in zone I (see Fig 5): 15 ' of arc.

25.16 Identification-of-colours test:

25.16.1 Test pieces: four windscreens shall be tested.

25.16.2 Identify the color of color-identification plate visually through the test area of test pieces.

It shall be tested for identifiability of the following colors: white, selective yellow, red, green, blue and amber.



In relation to the 'R' point,
test area shall be determined from the V points (see Fig 4), bounded by the intersection of the following four planes:
Plane 1: a plane inclined upwards from the X axis at 3 degrees, passing through V1, and parallel to the Y axis.
Plane 2: a plane inclined downwards from the X axis at 1 degrees, passing through V2, and parallel to the Y axis.
Plane 3: a vertical plane passing through V1 and V2 and inclined at 13 degrees to the left of the X axis.
Plane 4: a vertical plane passing through V1 and V2 and inclined at 20 degrees to the right of the X axis.

Fig 1. Test area A of windscreen

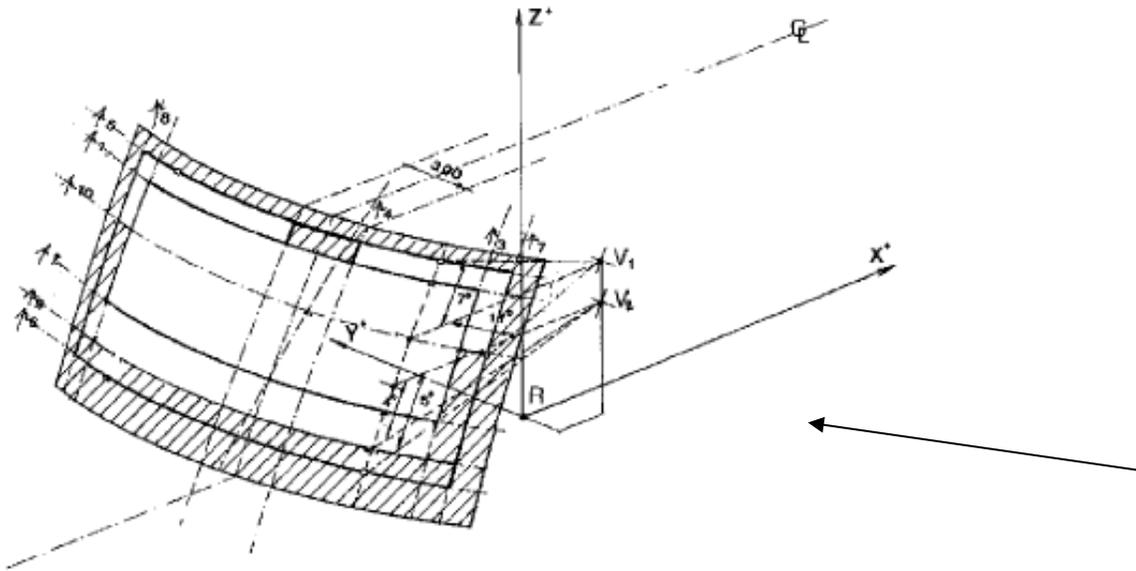


Fig 2. Test area B of windscreen (example 1)
Test Area B

In relation to the 'R' point,

test area shall be determined from the V points, bounded by the intersection of the following four planes:

Plane 5: a plane inclined upwards from the X axis at 7 degrees, passing through V1, and parallel to the Y axis.

Plane 6: a plane inclined downwards from the X axis at 5 degrees, passing through V2, and parallel to the Y axis.

Plane 7: a vertical plane passing through V1 and V2 and inclined at 17 degrees to the left of the X axis.

Plane 8: a plane symmetrical with respect to plane 7 in relation to the longitudinal median plane of the vehicle.

The reduced test plane B :

It 's the test area B with the exclusion of the following areas:

1. The test area A extended to the median plane of the vehicle, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle.
2. At the discretion of the vehicle manufacturer, one of the two following paragraphs may apply:
 - (1) any opaque obscuration bounded downwards by plane 1 and laterally by plane 4 and its symmetrical in relation to

- the longitudinal median plane of the vehicle (plane 4');
- (2) any opaque obscuration bounded downwards by plane 1 provided it is inscribed in an area 300 mm wide centred on the longitudinal median plane of the vehicle and provided the opaque obscuration below the plane 5 trace is inscribed in an area limited laterally by the traces of planes passing by the limits of a 150 mm wide segment and parallel respectively to the traces of planes 4 and 4'
3. Any opaque obscuration bounded by the intersection of the outer surface of the windscreen:
 - (1) with a plane inclined downwards from the X axis at 4 degrees, passing through V2, and parallel to the Y axis (plane 9);
 - (2) with plane 6.
 - (3) with planes 7 and 8 or the edge of the outer surface of the windscreen if the intersection of plane 6 with plane 7 (plane 6 with plane 8) doesn't cross the outer surface of the windscreen.
 4. Any opaque obscuration bounded by the intersection of the outer surface of the windscreen:
 - (1) with a horizontal plane passing through V1 (plane 10);
 - (2) with plane 3;
 - (3) with plane 7 or the edge of the outer surface of the windscreen if the intersection of plane 6 with plane 7 (plane 6 with plane 8) doesn't cross the outer surface of the windscreen;
 - (4) with plane 9.
 5. An area within 25 mm from the edge of the outer surface of the windscreen or from any opaque obscuration. This area shall not impinge on the area in item 1. (i.e. the extended test area A).

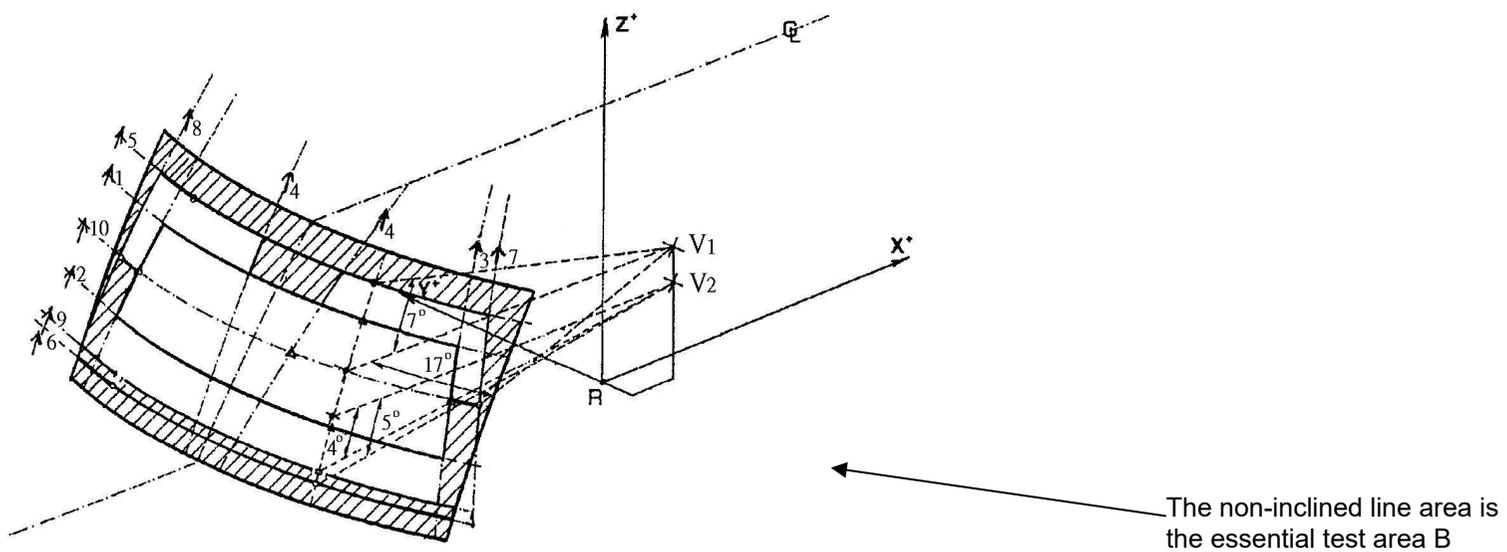
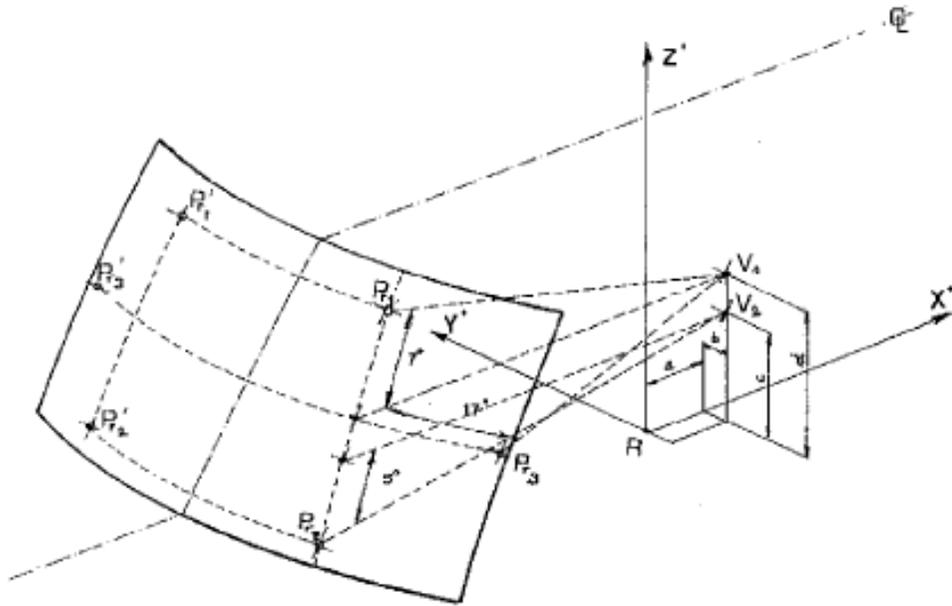


Fig 3. Test area B of windscreen (example 2)



1. Following gives the basic co-ordinates a, b, c and d for a design seat-back angle of 25 degrees:

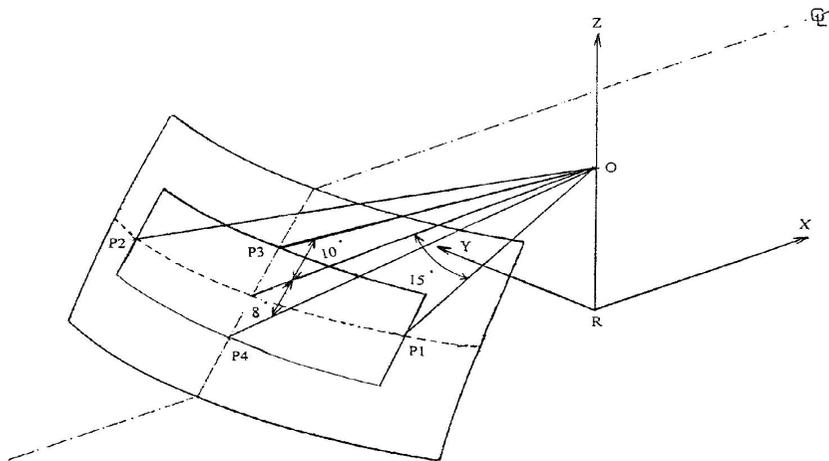
V-point a: $V1 = 68\text{mm}$, $V2 = 68\text{mm}$.

V-point b: $V1 = -5\text{mm}$, $V2 = -5\text{mm}$.

V-point c (d): $V1 = 665\text{mm}$, $V2 = 589\text{mm}$.

2. Table 1 shows the further corrections to be made to the X and Z co-ordinates of each 'V' point when the design seat-back angle is not 25 degrees.

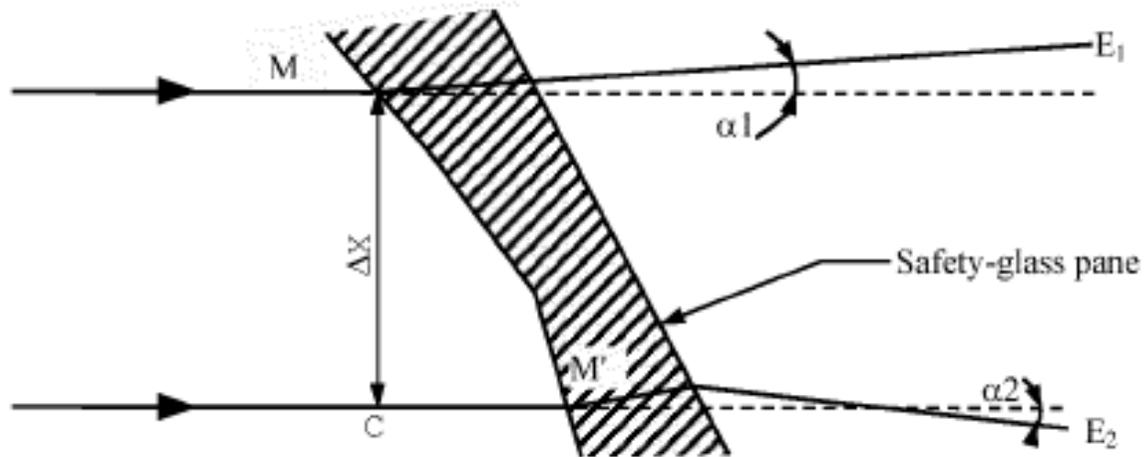
Fig 4. Determination of V points



Note:

1. Zone I is the windscreen zone determined by the intersection of the windscreen with the four planes defined below:
 - P₁: a vertical plane passing through O and forming an angle of 15 degrees to the left of the median longitudinal plane of the vehicle;
 - P₂: a vertical plane symmetrical to P₁ about the median longitudinal plane of the vehicle. If this is not possible (in the absence of a symmetrical median longitudinal plane, for instance) P₂ shall be the plane symmetrical to P₁ about the longitudinal plane of the vehicle passing through point O.
 - P₃: a plane passing through the straight line OQ and forming an angle of 10 degrees above the horizontal plane;
 - P₄: a plane passing through the straight line OQ and forming an angle of 8 degrees below the horizontal plane.
2. The "eye-point" O which is the point located 625 mm above the point R of the driver's seat in the vertical plane parallel to the longitudinal median plane of the vehicle for which the windscreen is intended, passing through the axis of the steering wheel.
3. The straight line OQ which is the horizontal straight line passing through the eye point O and perpendicular to the median longitudinal plane of the vehicle.

Fig 5. Test area I



Note: $\Delta\alpha = \alpha_1 - \alpha_2$ is the optical distortion in the direction M-M'.
 $\Delta x = MC$ is the distance between two straight lines parallel to the direction of vision and passing through the points M and M'.

Fig 6. Diagrammatic representation of optical distortion

Table 1. Correction for design seat-back angles other than 25 degrees

Seatback angle(in degrees)	Horizontal coordinates X	Vertical coordinates Z	Seatback angle(°)	Horizontal coordinates X	Vertical coordinates Z
5	-186 mm	28 mm	23	- 17mm	5 mm
6	-176 mm	27 mm	24	- 9 mm	2 mm
7	-167 mm	27 mm	25	0 mm	0 mm
8	-157 mm	26 mm	26	9 mm	- 3 mm
9	-147 mm	26 mm	27	17 mm	- 5 mm
10	-137 mm	25 mm	28	26 mm	- 8 mm
11	-128 mm	24 mm	29	34 mm	-11 mm
12	-118 mm	23 mm	30	43 mm	-14 mm
13	-109 mm	22 mm	31	51 mm	-17 mm
14	- 99 mm	21 mm	32	59 mm	-21 mm

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15	- 90 mm	20 mm	33	67 mm	-24 mm
16	- 81 mm	18 mm	34	76 mm	-28 mm
17	- 71 mm	17 mm	35	84 mm	-31 mm
18	- 62 mm	15 mm	36	92 mm	-35 mm
19	- 53 mm	13 mm	37	100 mm	-39 mm
20	- 44 mm	11 mm	38	107 mm	-43 mm
21	- 35 mm	9 mm	39	115 mm	-47 mm
22	- 26 mm	7 mm	40	123 mm	-52 mm

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