

Unofficial Translation

In the event of any doubt or misunderstanding arising from this translation, the standard in Thai will be held to be authoritative.

**Thai Industrial Standard
For
Automobile Safety Glasses :
Laminated Safety Glass
TIS 196-2536(1993)**

1. Scope

- 1.1 This standard specifies grades, thickness and tolerances, material, requirements, mark and label, sampling and criteria for conformity and testing for automobile safety glasses: laminated glass.
- 1.2 This standard covers laminated safety glass which is transparent, both coloured and colourless, intended to be used for windscreen and other parts; it does not cover safety glass made for the purpose of bullet resistance.

2. Definitions

For the purpose of this standard the following definitions apply:

- 2.1 SAFETY GLASS: A glass which has been subjected to a specific treatment such that, if fractured, it is less likely to cause severe cuts or serious physical injuries.
- 2.2 AUTOMOTIVE SAFETY GLASSES: LAMINATED SAFETY GLASS hereinafter referred to as LAMINATED GLASS: A safety glass for automobile part made by uniting firmly two or more sheets of glass to, and alternating with, interlayer such that fracture does not cause the glass to separate from the interlayer to any substantial extent and in general the product does not break into large fragments.
- 2.3 INTERLAYER: Polyvinylbutyral plastic material which, when used under a specified condition in the manufacture of laminated glass, shall be of a transparent form having the ability to hold the sheets of glass together.
- 2.4 SCRATCH: Scar produced on the glass surface either during manufacturing or handling process of the product. The scar can be classified as heavy and light. A heavy scar can be easily felt but a light scar may not.
- 2.5 INCLUSION MATERIALS: Coloured bubbles, unmelted substances and devitrification contained in the glass.
- 2.6 LINT: Foreign material of waste yarn or hair found in the interlayer during manufacturing process of laminated glass.
- 2.7 DARK SPOT: Material stuck on the interlayer which may not be clearly seen in the interlayer itself, but become quite distinct when used in the laminated glass.
- 2.8 PRIMARY VISION AREA: The part of the windscreen through which the principal field of view is obtained as in Figure 1.

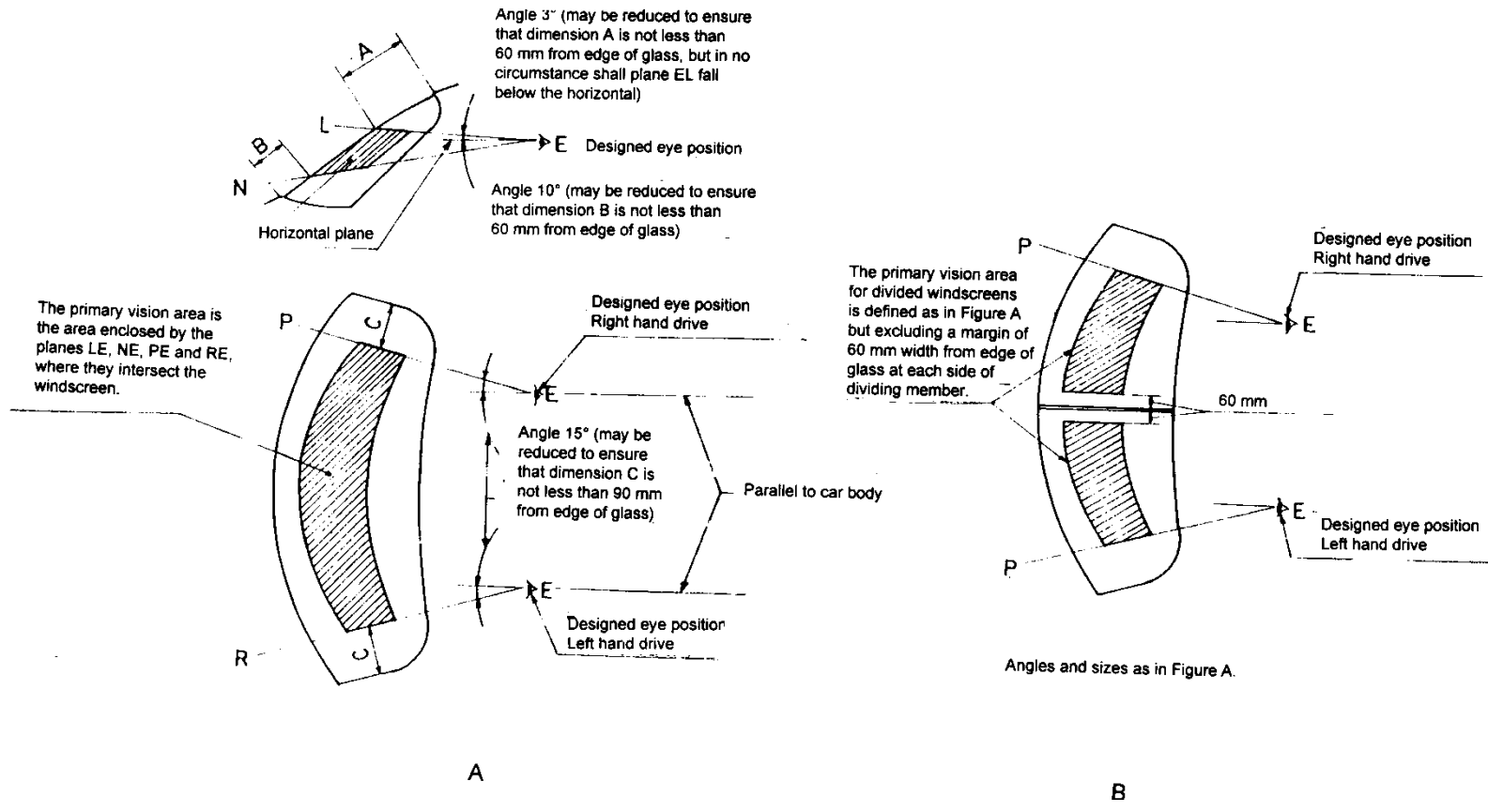


Figure 1 Primary vision area for optical tests on windscreen (clause 2.8)

- 2.9 SECONDARY IMAGE: A spurious image usually seen at night when the object being viewed is very bright in relation to its surroundings, e.g. the headlight of an approaching vehicle is seen as a bright primary image with at least one less bright juxtaposed secondary image.
- 2.10 NOMINAL THICKNESS OF LAMINATED GLASS: The sum of the nominal thicknesses of all sheets of glass and the nominal thicknesses of all interlayers.

3. Grades

- 3.1 Laminated glass is classified by the nominal thickness of the interlayer into 2 grades:
- 3.1.1 Grade A - Nominal thickness of interlayer: 0.76 mm
- 3.1.2 Grade B - Nominal thickness of interlayer: 0.38 mm

4. Thickness and tolerances

- 4.1 Thickness and tolerances
- 4.1.1 The nominal thickness of laminated glass shall be as specified by the manufacturer.
- 4.1.2 Tolerances on thickness shall be
 $\pm 0.2 n$ for nominal thickness of each glass sheet not exceeding 3 mm
 $\pm 0.3 n$ for nominal thickness of each glass sheet exceeding 3 mm
where n is the number of sheets of glass.
- Test shall conform to TIS 195, "Test methods for automobile safety glasses".

5. Material

- 5.1 It is recommended that laminated glass be made of float glass.

6. Requirements

- 6.1 Appearance
Appearance shall conform to Table 1.
Test shall be in accordance with TIS 195.
- 6.2 Visible light transmission
When tested as in TIS 195, the rate of visible light transmission shall not be less than 70%.
- 6.3 Secondary image separation (windscreen only)
When tested as in TIS 195, the maximum secondary image separation shall not exceed 15 minutes of arc when viewed through the primary vision area.
- 6.4 Distortion of vision
When tested as in TIS 195, the angular deviation changes shall not exceed 15 minutes of arc when viewed through the primary vision area.

Table 1
Appearance of laminated glass
(clause 6.1)

Defect	Limitation
Bubbles	Length : 3.0 mm - 15.0 mm Width : 1.0 , max.
Scratches	Heavy : 3.0 mm - 15.0 mm long Light : 5.0 mm - 30.0 mm long
Inclusion materials	0.5 mm - 1.5 mm long
Lint	0.5 mm - 30.0 mm long
Dark spot	0.5 mm - 2.5 mm long
Aggregate of above defects	(1) Aggregate of defects of dimension below the corresponding minimum given above may be allowed provided that the visible light transmission is not impaired when tested according to TIS 195. (2) Aggregate of up to 5 defects within allowable limits of size and length given above may be allowed within an arbitrary circle of 300 mm provided that among these there is not more than 1 large defect. Large defects involve the following: Bubbles 10.0 mm - 15.0 mm long Heavy scratches 10.0 mm - 15.0 mm long
Slide	The non-exposed slide shall not exceed 1.5 mm.
Tong mark	Permissible in the area not exceeding 8 mm from the periphery for flat glass. Permissible in the area not exceeding 12 mm from the periphery for curved glass.
Mold mark	Permissible in the area not exceeding 12 mm from the periphery for curved glass.
Crack	Not permissible
Edge chipping	Permissible in the area not exceeding 1.0 mm from the periphery. Unexposed chipping allowed up to the concealing range, none which might be obstacle in use.

6.5 Colour identification (windscreen only)

When tested as in TIS 195, the colour white, yellow, red, green, blue and amber on the colour board shall be identifiable.

6.6 Abrasion resistance

When tested as in TIS 195, the haze value shall not exceed 2%.

6.7 Resistance to high temperature

When tested as in TIS 195, the test piece may crack, but no bubbles or other defects shall develop beyond 15 mm from the periphery of the test piece or 10 mm from the crack. Where the test piece is prepared from the product sample, no bubbles or other defects shall develop beyond 25 mm from the periphery of the cut test piece.

6.8 Resistance to radiation

When tested as in TIS 195, the following shall be complied with:

$$6.8.1 \quad \frac{b}{a} \times 100 \geq 95\%$$

$$6.8.2 \quad b \geq 70\%$$

where a is the rate of visible light transmission before radiation

b is the rate of visible light transmission after radiation

6.8.3 There is no noticeable change of colour, bubble and turbidity.

6.9 Resistance to humidity

When tested as in TIS 195, there shall be no noticeable change of colour, bubbles or turbidity in the area exceeding 10 mm from the periphery of the test piece when the test piece is the entire sheet of the product, or 15 mm when the test piece is cut from the product sample.

6.10 Impact resistance - head form test (windscreen only)

When tested as in TIS 195, either clause 6.10.1 or 6.10.2 shall be complied with:

6.10.1 Where the product is used as test piece

6.10.1.1 The glass shall be broken producing a large number of circular cracks centered on the point of impact with the nearest crack spaced at not more than 80 mm from the point of impact.

6.10.1.2 The glass fragments shall remain attached to the interlayer. Fragments less than 4 mm wide may leave the test piece but shall be outside the radius of 60 mm from the point of impact.

6.10.1.3 Areas on the surface of the impact in which fragments leave the test piece exposing the interlayer shall not exceed 20 cm².

6.10.1.4 The interlayer may be torn but to a length of not more than 35 mm.

6.10.2 Where separate test pieces are prepared

6.10.2.1 The glass shall be broken producing a large number of circular cracks centered on the point of impact.

6.10.2.2 The test head form shall not penetrate the test piece.

6.10.2.3 No large fragments shall leave the interlayer.

6.11 Resistance to penetration (windscreen only)

When tested as in TIS 195, the steel ball shall not penetrate the test piece within 5 seconds after the impact.

6.12 Impact resistance

When tested as in TIS 195, the following shall be complies with:

6.12.1 Windscreen

6.12.1.1 The steel ball shall not penetrate the test piece.

6.12.1.2 The mass of spalling of the glass surface opposite the point of impact shall not exceed the limit given in Table 2.

6.12.2 Other parts

6.12.2.1 The steel ball shall not penetrate the test piece.

6.12.2.2 The mass of spalling of the glass surface opposite the point of impact shall exceed 15 g.

Table 2
Mass of spalling of glass surface opposite point of impact
(clause 6.12.1.2)

Units in g

Measured thickness of laminated glass	Mass of spalling of glass surface opposite point of impact	
	40 °C	- 20 °C
Up to 4.5	12	
Over 4.5 up to 5.5	15	
Over 5.5 up to 6.5	20	
Over 6.5	25	

7. Mark and label

- 7.1 There shall be at least number, letter or mark indicating clearly, legibly and durably the following information at any corner on each pane of laminated safety glass.
- (1) The term "Laminated glass" or "Laminated" or the letter "L"
 - (2) Grade
 - (3) Name of manufacturer or factory, or registered trade mark
- 7.2 There shall be at least number, letter or mark indicating clearly and legibly the following information on each package.
- (1) The term "Laminated glass" or "Laminated" or the letter "L"
 - (2) Grade
 - (3) Thickness in millimetres
 - (4) Number of sheets in package
 - (5) Lot code
 - (6) Name of manufacturer or factory, or registered trade mark
- 7.3 In case foreign language is used, the meaning shall correspond to that in Thai specified above.
- 7.4 Any person who manufactures products complying with this standard may use the Standards Mark in connection with his products only after having received a license from the Industrial Product Standards Council.

8. Sampling and criteria for conformity

- 8.1 Lot: Laminated glasses of the same grade and thickness made from the same material under the same conditions and in the same continuous run which are manufactured or delivered or purchased at one time.
- 8.2 Sampling and acceptance shall comply with the following plan or other technically equivalent plan.
- 8.2.1 Sampling and acceptance for test on thickness, appearance, visible light transmission and abrasion resistance
- 8.2.1.1 Three samples shall be drawn at random from a lot as test pieces.
 - 8.2.1.2 Provided all the test pieces comply with the requirements of clauses 4.1, 6.1, 6.2 and 6.6, that lot shall be deemed to comply with the requirements.

- 8.2.2 Sampling and acceptance of windscreen for tests on secondary image separation, distortion of vision and colour identification
- 8.2.2.1 Four samples shall be drawn at random from a lot as test pieces.
- 8.2.2.2 Provided all the test pieces comply with clauses 6.3, 6.4 and 6.5, that lot shall be deemed to comply with the requirements.
- 8.2.3 Sampling and acceptance for tests on resistance to high temperature, radiation and humidity
- 8.2.3.1 Nine samples shall be drawn at random from a lot as test pieces, three required for each test item.
- 8.2.3.2 Provided all the test pieces comply with all the requirements of clauses 6.7, 6.8 and 6.9, that lot shall be deemed to comply with the requirements.
- Failure of more than one test piece to comply with any of the requirements of clauses 6.7, 6.8 or 6.9 shall constitute failure of the lot to meet the requirements.
- If one test piece fails to comply with any of clause 6.7, 6.8 or 6.9, 3 additional samples shall be drawn for retest all of which shall comply with the requirement of clause 6.7, 6.8 or 6.9, as applicable, for the lot to be deemed in compliance with the requirement.
- 8.2.4 Sampling and acceptance for test on impact resistance - head form test (for windscreen only)
- 8.2.4.1 Sampling
- (1) Where the product sample is used as test piece
Four samples shall be drawn at random as test pieces
- (2) Where separate test pieces are prepared
Six test pieces shall be prepared by the same process used in the manufacturing of the product.
- 8.2.4.2 Acceptance
- (1) Where the product sample is used as test piece
Provided all the test pieces comply with clause 6.10.1, that lot shall be deemed to comply with the requirement.
Failure of more than 1 test piece to comply with clause 6.10.1 shall constitute failure of the lot to meet the requirement.
If 1 test piece fails to comply with clause 6.10.1, 4 more test pieces shall be drawn for retest all of which shall meet the requirement of clause 6.10.1 for the lot to be deemed in compliance with the requirement.
- (2) Where separate test pieces are prepared
Provided all the test pieces comply with clause 6.10.2, that lot shall be deemed to comply with the requirement.
Failure of more than 1 test piece to comply with clause 6.10.2 shall constitute failure of the lot to meet the requirement.
If 1 test piece fails to comply with clause 6.10.2, 6 more test pieces shall be drawn for retest all of which shall meet the requirement of clause 6.10.2 for the lot to be deemed in compliance with the requirement.
- 8.2.5 Sampling and acceptance for test on resistance to penetration (windscreen only)
- 8.2.5.1 Six samples shall be drawn at random from a lot as test pieces.
- 8.2.5.2 Provided all the test pieces comply with clause 6.11, that lot shall be deemed to comply with the requirement.
- 8.2.5.3 Failure of more than 1 test piece to comply with clause 6.11 shall constitute failure of the lot to meet the requirement.

8.2.5.4 If 1 test piece fails to comply with clause 6.11, 6 more test pieces shall be drawn for retest all of which shall meet the requirement of clause 6.11 for the lot to be deemed in compliance with the requirement.

8.2.6 Sampling and acceptance for test on impact resistance

8.2.6.1 Sampling

(1) Windscreen

Twenty samples shall be drawn at random from a lot as test pieces, 10 required for test at each temperature limit.

(2) Other parts

Four samples shall be drawn at random from a lot as test pieces.

8.2.6.2 Acceptance

(1) Windscreen

Provided that at each temperature at least 8 test pieces comply with clause 6.12.1, that lot shall be deemed to comply with the requirement.

If at either temperature more than 2 test pieces fail to comply with clause 6.12.1, 10 more test pieces shall be drawn for retest at the same temperature as the failing ones and shall meet the requirement of clause 6.12.1 for the lot to be deemed in compliance with the requirement.

(2) Other parts

Provided all the test pieces comply with clause 6.12.2, that lot shall be deemed to comply with the requirement.

Failure of more than 2 test pieces to comply with clause 6.12.2 shall constitute failure of the lot to meet the requirement.

If not more than 2 test pieces fail to comply with clause 6.12.2, 4 more test pieces shall be drawn for retest all of which shall meet the requirement of clause 6.12.2 for the lot to be deemed in compliance with the requirement.

8.3 Criteria for conformity

Provided the samples meet all the requirements of clauses 8.2.1.2, 8.2.2.2, 8.2.3.2, 8.2.4.2, 8.2.5.2 and 8.2.6.2 that lot of laminated glass shall be deemed to comply with this standard.