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(FGMAJ/JSA)

**Test methods of safety glazing materials
for road vehicles**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Flat Glass Manufacturers Association of Japan (FGMAJ)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS R 3212:2015**), which has been technically revised.

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Test methods of safety glazing materials for road vehicles

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 3537** : 2015, Edition 4, **ISO 3538** : 1997, Edition 3, **ISO 3917** : 2016, Edition 4, and **ISO 15082** : 2016, Edition 2, with some modifications of the technical contents to correspond to the relevant laws and regulations in Japan.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB. Annex JA is unique to **JIS** and not given in the corresponding International Standard.

1 Scope

This Standard mainly specifies the test methods for safety glazing materials to be used for road vehicles (hereafter referred to as safety glass).

NOTE The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 3537 : 2015 *Road vehicles — Safety glazing materials — Mechanical tests*

ISO 3538 : 1997 *Road vehicles — Safety glazing materials — Test methods for optical properties*

ISO 3917 : 2016 *Road vehicles — Safety glazing materials — Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering*

ISO 15082 : 2016 *Road vehicles — Tests for rigid plastic safety glazing materials* (Overall evaluation: MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS B 7502 *Micrometers*

JIS B 7754 *Light-exposure and light-and-water-exposure apparatus (xenon-arc lamp type)*

JIS D 0205	<i>Test method of weatherability for automotive parts</i>
JIS K 2202	<i>Motor gasoline</i>
JIS K 8102	<i>Ethanol (95) (Reagent)</i>
JIS K 8891	<i>Methanol (Reagent)</i>
JIS R 3211	<i>Safety glazing materials for road vehicles</i>
JIS Z 8401	<i>Rounding of numbers</i>
JIS Z 8703	<i>Standard atmospheric conditions for testing</i>
JIS Z 8722	<i>Methods of colour measurement — Reflecting and transmitting objects</i>
JIS Z 8781-3	<i>Colorimetry — Part 3 : CIE tristimulus values</i>
JIS Z 8801-1	<i>Test sieves — Part 1 : Test sieves of metal wire cloth</i>
ISO 12103-1	<i>Road vehicles — Test contaminants for filter evaluation — Part 1 : Arizona test dust</i>
ISO 20176 : 2011	<i>Road vehicles — H-point machine (HPM-II) — Specifications and procedure for H-point determination</i>

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS R 3211** apply.

4 Test items

The test items shall be as follows.

- a) Thickness measurement (5.2)
- b) Fragmentation test (5.3)
- c) Impact resistance test (5.4)
- d) Penetration resistance test (5.5)
- e) Head-form (human head manikin) impact test (5.6)
- f) Abrasion resistance test (5.7)
- g) High temperature resistance test (5.8)
- h) Radiation resistance test (5.9)
- i) Humidity test (5.10)
- j) Regular luminous transmission test (5.11)
- k) Optical distortion test (5.12)
- l) Secondary image separation test (5.13)
- m) Chemical resistance test (5.14)

- n) Fire resistance test (5.15)
- o) Simulated weathering test (5.16)
- p) Temperature dependency test (5.17)
- q) Flexibility test (5.18)
- r) Adhesion test (cross-cut test) (5.19)

5 Conditions of test location and test methods

5.1 Conditions of test location

The atmospheric conditions of the test location shall be as follows.

The temperature at which a specimen is maintained for a specified period immediately preceding the test and the temperature or relative humidity inside the test apparatus during tests shall be as specified in 5.2 to 5.19.

- a) **Temperature of test location**, the ordinary temperature ($20\text{ }^{\circ}\text{C} \pm 15\text{ }^{\circ}\text{C}$) specified in JIS Z 8703.
- b) **Atmospheric pressure of test location**, $0.86 \times 10^2\text{ kPa}$ to $1.06 \times 10^2\text{ kPa}$.
- c) **Relative humidity of test location**, $(60 \pm 20)\%$.

5.2 Thickness measurement

The thickness measurement shall be as follows.

- a) **Purpose** Determination of thickness of a safety glass.
- b) **Specimen** A whole product or test piece (100 mm × 100 mm, 300 mm × 300 mm, 1 100 mm × 500 mm or other size).
- c) **Instrument used** A micrometer 0.01 mm in scale interval specified in JIS B 7502 or an equivalent or superior instrument.
- d) **Procedure** Measure the thickness of the specimen at two or more randomly selected, approximately equally spaced points not more than 25 mm from the edges of the specimen by means of the instrument specified in c), and round the measured results to one decimal place according to the method specified in b) 2) of Clause 2 of JIS Z 8401. The measuring points of a product designed to be uneven in thickness shall be as agreed between the parties concerned.

5.3 Fragmentation test

5.3.1 Fragmentation test of zone-toughened glass

The fragmentation test of zone-toughened glass shall be as follows.

- a) **Purpose** Assessment of the ability of a zone-toughened glass to fracture in a manner that ensures desired safety in the event of breakage.
- b) **Specimens** Six whole products
- c) **Apparatus and instrument used** The apparatus and instrument used shall be as

follows.

- 1) Hammer with a pointed head $0.2 \text{ mm} \pm 0.05 \text{ mm}$ in curvature radius or an automatic punch.
 - 2) Counting frames $50 \text{ mm} \times 50 \text{ mm}$, $500 \text{ mm} \times 200 \text{ mm}$ and $500 \text{ mm} \times 150 \text{ mm}$ in size.
- d) **Division of specimen** A specimen is divided into three areas as shown in Figure 1.
- 1) **Peripheral area** An area of at least 70 mm around the periphery of the specimen.
 - 2) **See-through area** A rectangular area at least 500 mm wide and 200 mm long (rectangular area 500 mm wide and 150 mm long for specimens less than 440 mm in height), the central point (point 1 in Figure 1) of which shall be as follows :

V_1 point, V_2 point and O point, and YZ plane shall be in accordance with **JA.1.1**.

 - 2.1) For category M_1 vehicles, the intersection of the straight vertical line passing through the midpoint between V_1 and V_2 and perpendicular to YZ plane with the windscreen.
 - 2.2) For vehicles of other category than M_1 , the intersection of the straight vertical line passing through O point and perpendicular to YZ plane with the windscreen.
 - 3) **Intermediate area** An area outside the see-through area not more than 50 mm wide.
- e) **Points of impact** The points of impact shall be situated as follows :
- point 1, centre of the see-through area;
 - point 2, in the intermediate area, the point nearest to the see-through area on the vertical line of symmetry of the see-through area;
 - points 3 and 3', 30 mm from the edges, on the shortest median of the specimen; when there is a tong mark, one point shall be on the tong mark side and the other on the opposite side;
 - point 4, on the longest median of the specimen at the point of minimum curvature;
 - point 5, 30 mm toward the centre from the midpoint of the corner edge of the sample where the radius of curvature is smallest, either to the left side or to the right side.

The points of impact are shown in Figure 1.

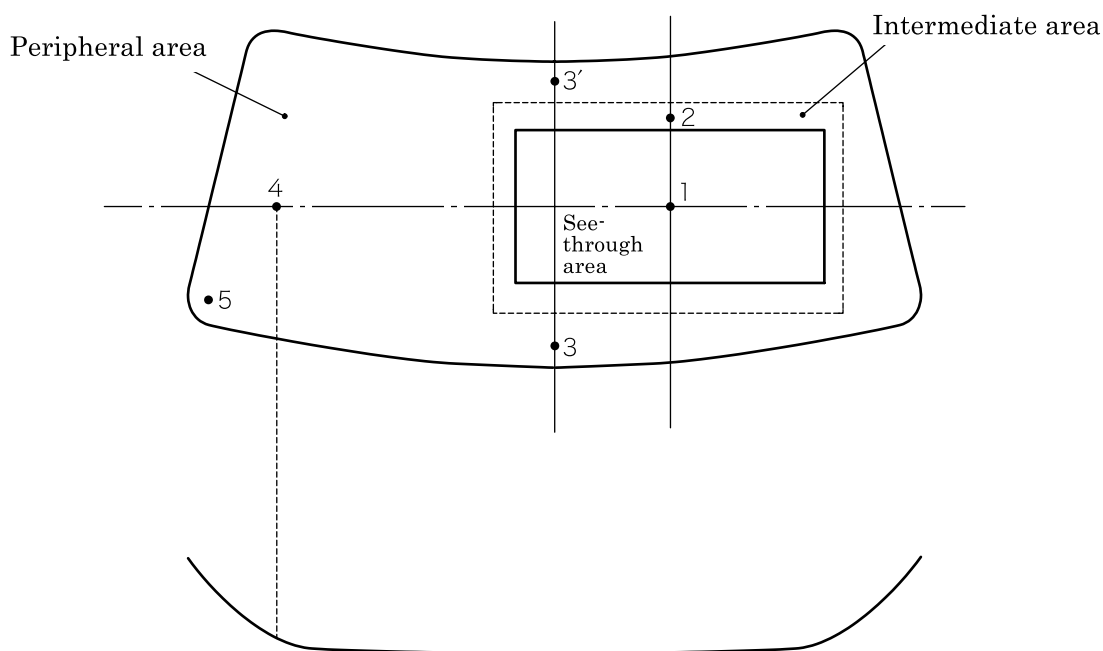


Figure 1 Division of specimen and points of impact

f) **Procedure** The procedure shall be as follows.

- 1) Support the specimen so that, when it is fractured, fragments will not scatter.
- 2) Using a hammer or punch, break the specimen by striking the points of impact as indicated in Figure 1.

Use one specimen for test at each impact point.

- 3) Immediately observe the fragmentation of the specimen, and perform counting and measurement in accordance with g).

For this observation, a photosensitive paper may be used, in which case the photographic image on the paper shall be inspected.

g) **Counting and measurement of fragments** The counting and measurement of fragments shall be as follows.

1) **Peripheral area**

- 1.1) Select the portions where the size of fragments is the coarsest and the finest, and count the number of fragments in these portions using the counting frame of 50 mm × 50 mm. When the number of fragments in the counting frame of 50 mm × 50 mm is less than 40, count the number of fragments in the counting frame of 100 mm × 100 mm including the 50 mm × 50 mm area.

The fragments on the edges of the counting frame shall be counted as 0.5 piece.

- 1.2) Count the number of fragments larger than 3 cm² and measure the area of each fragment.

- 1.3) Count the number of slender fragments longer than 75 mm and measure the length of each such fragment.
- 1.4) Measure the angle between a slender fragment extending to the edge of the specimen and the edge of the specimen, and measure the length of the fragment.
- 1.5) Exclude from evaluation the areas 20 mm from the edges of the specimen and within a radius of 75 mm from the point of impact.

2) See-through area

- 2.1) **Evaluation area of overall area of fragments of 2 cm² or over** The evaluation area of the see-through area shall be a rectangular area 500 mm wide and 200 mm long including the intersecting point of the specimen with the straight horizontal line parallel to the vehicle median passing through the midpoint between V₁ and V₂ in the case of category M₁ and through O point in the case of other category than M₁. When the V point (V₁ and V₂) or O point is not applicable, it shall be a rectangular area 500 mm wide and 200 mm long located at the approximate front of the driver's seat. For specimens less than 440 mm in height, it shall be a rectangular area 500 mm wide and 150 mm long.

- 2.2) Calculate the total area of fragments 2 cm² or larger within the evaluation area.

A fragment lying on the periphery of the evaluation area shall be included in the evaluation if its overlap with the evaluation area is 2 cm² or more.

- 2.3) Count the number of fragments with an area larger than 16 cm² and measure the area of each such fragment.
- 2.4) Count the number of fragments with a length greater than 100 mm and measure the length of each such fragment.
- 2.5) Count the number of fragments with an area larger than 2 cm² and having sharp portions projecting outside the circle of 40 mm diameter within any rectangle of 500 mm × 200 mm (rectangular area 500 mm wide and 150 mm long for specimens less than 440 mm in height).
- 3) **Intermediate area** Compare the fragmentation of the peripheral area and the see-through area with that of the intermediate area.

5.3.2 Fragmentation test of toughened glass

The fragmentation test of toughened glass shall be as follows.

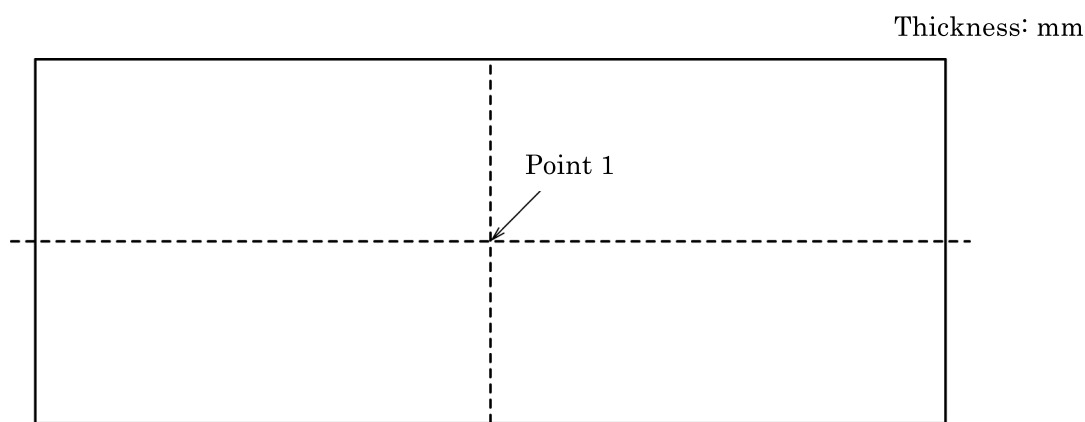
- a) **Purpose** Assessment of the ability of a toughened glass to fracture in a manner that ensures desired safety in the event of breakage.
- b) **Specimens** For flat or curved (minimum radius curvature 200 mm or more) safety glass, four whole products, and for curved (minimum radius curvature less than 200 mm) safety glass, four whole products per one point of impact
- c) **Apparatus and instrument used** The apparatus and instrument used shall be as follows.

- 1) Hammer with a pointed head $0.2 \text{ mm} \pm 0.05 \text{ mm}$ in curvature radius or an automatic punch.
 - 2) Counting frame $50 \text{ mm} \times 50 \text{ mm}$ in size.
- d) **Points of impact** The points of impact shall be situated as follows :

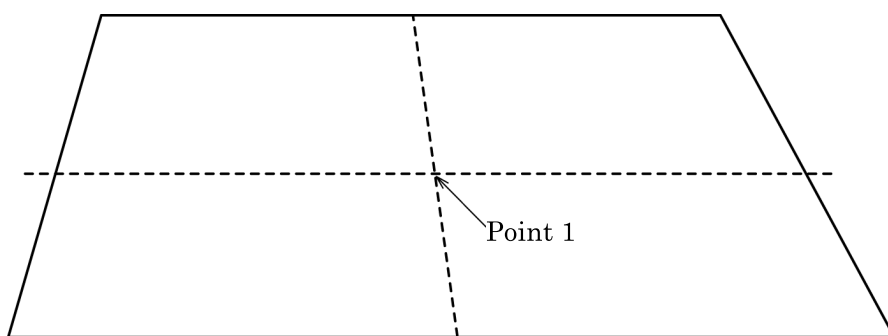
point 1, at approximate centre of the specimen;

point 2, on the longest median at the point of minimum curvature, applicable to curved specimens with a minimum radius curvature of less than 200 mm.

The points of impact are shown in Figure 2. For point 2, one of the two points illustrated in the figure that satisfies the above condition shall be selected.

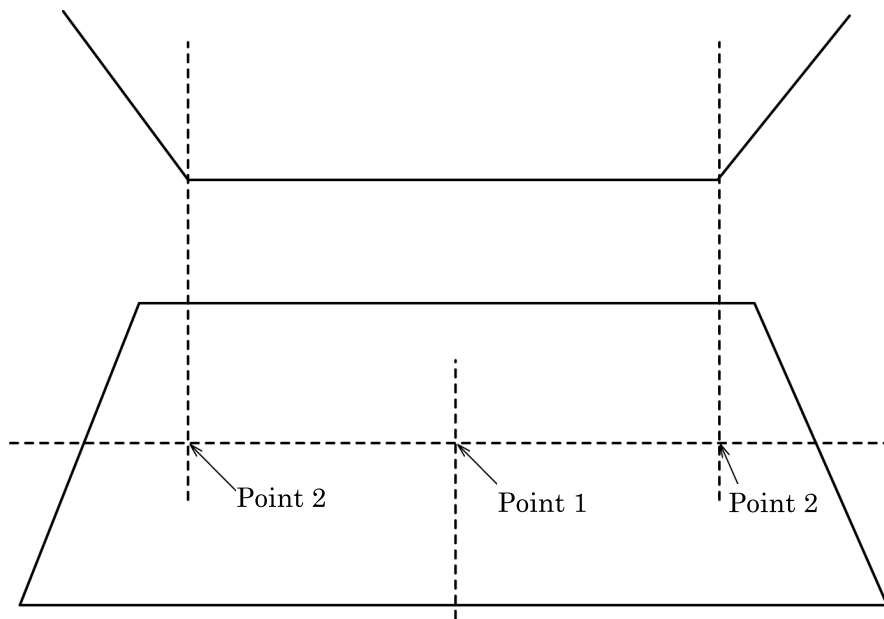


- a) **Flat or curved (minimum radius curvature 200 mm or more) specimen (rectangular)**



- b) **Flat or curved (minimum radius curvature 200 mm or more) specimen (other than rectangular)**

Figure 2 Points of impact



c) Curved (minimum radius curvature less than 200 mm) specimen

Figure 2 (concluded)

e) **Procedure** The procedure shall be as follows.

- 1) Support the specimen so that, when it is fractured, fragments will not scatter.
- 2) Using a hammer or punch, break the specimen by striking the points of impact as indicated in Figure 2.

Use one specimen for test at each point of impact.

- 3) Immediately observe the fragmentation of the specimen, and perform counting and measurement in accordance with f).

For this observation, a photosensitive paper may be used, in which case the photographic patterns obtained on the paper shall be inspected.

f) **Counting and measurement of fragments** The counting and measurement of fragments shall be as follows.

- 1) Select the portions where the size of fragments is the coarsest, and count the number of fragments in these portions using the counting frame of 50 mm × 50 mm.

The fragments on the edges of the counting frame shall be counted as 0.5 piece.

- 2) Count the number of fragments larger than 3 cm² and measure the area of each fragment.
- 3) Count the number of slender fragments longer than 100 mm and measure the length of each such fragment.
- 4) Measure the angle between a slender fragment extending to the edge of the

specimen and the edge of the specimen, and measure the length of the fragment.

- 5) Exclude from evaluation the areas 20 mm from the edges of the specimen and within a radius of 75 mm from the point of impact.

5.4 Impact resistance test

The impact resistance test shall be as follows.

- a) **Purpose** Determination of whether the safety glass has a certain minimum cohesion or strength under impact from a small hard flying object.
- b) **Specimens** Specimens of laminated glass, toughened glass, plastic glazing or glass-plastics approximately 300 mm × 300 mm in dimensions manufactured in the same way as the product.

Flat specimens approximately 300 mm × 300 mm in dimensions cut out from a flat product or specimens of the said dimensions cut out from the flattest part of a curved product may be used. Number of specimens used shall be in accordance with Table 1.

Table 1 Number of specimens

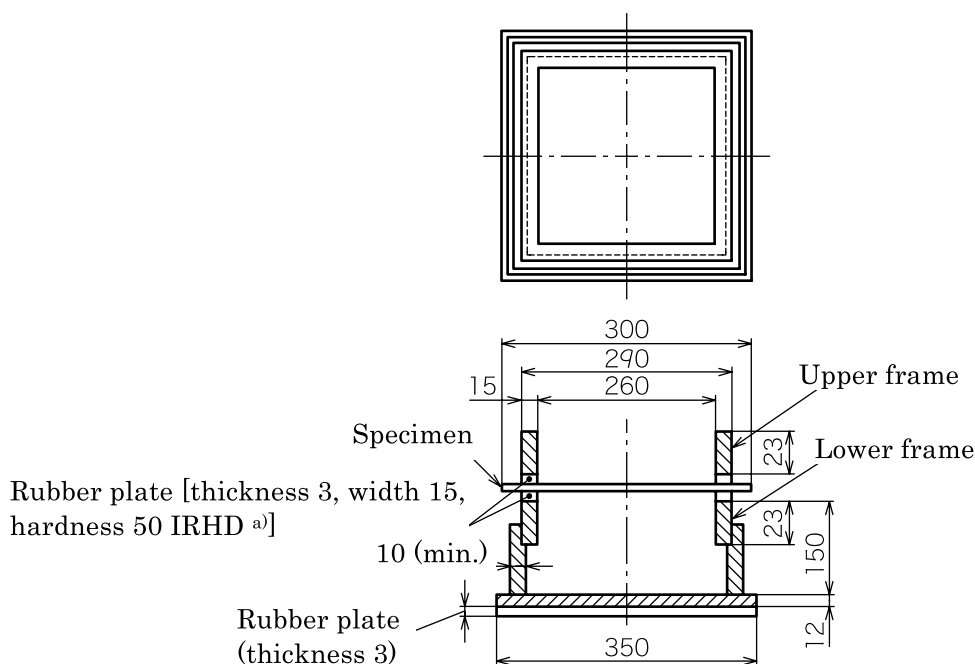
Type	Windscreen	Unit: sheets
		Windows other than windscreen, and windscreen of road vehicles less than 40 km/h in maximum speed and other road vehicles
Laminated glass A Glass-plastics	10	4
Laminated glass B	6	4
Toughened glass	—	6
Plastic glazing	10	10

- c) **Apparatus and instrument used** The apparatus and instrument used shall be as follows.
- 1) **Steel ball**, 227 g ± 2 g in mass, approximately 38 mm in diameter, with smooth surface.
- 2) **Ball dropping equipment**, capable of dropping the steel ball freely from a height specified in Table 2.

Any equipment capable of providing results equivalent to the specification values may be used.

- 3) **Supporting fixture**, a steel frame shown in Figure 3.

Unit: mm



Note ^{a)} Equivalent to the durometer hardness of A50 in **JIS K 6253-3**.

Figure 3 Supporting fixture

d) **Procedure** The procedure shall be as follows.

- 1) Condition the specimen for at least 4 h immediately preceding the test in a room at a temperature of $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $-20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for laminated glass A and glass-plastics used for the windscreen, and in a room at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for plastic glazing. The impact test at $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ shall only be performed after the humidity resistance test.

In the case of laminated glass B, and laminated glass A and glass-plastics used for other windows than the windscreen, condition the specimen in a room at a temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. In the case of plastic glazing, condition the specimen for at least 4 h immediately preceding the test at a temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $(50 \pm 5)\%$.

- 2) Place the specimen in the horizontally held fixture so that the surface of the specimen which represents the outside face of the safety glass when mounted on the vehicle faces upwards.
- 3) Allow to drop the steel ball in standstill condition with no application of external force from a height specified in Table 2 onto the centre of the specimen. The point of impact shall be within 25 mm of the geometric centre of the specimen for a drop height less than or equal to 6 m, and within 50 mm of the centre of the specimen for a drop height greater than 6 m. The ball shall be allowed to make only one impact on one specimen.

Table 2 Drop height

Unit: mm

Type	Application	Nominal thickness (mm)	Drop height		
			40 °C	−20 °C For plastic glazing, −18 °C	23 °C For plastic glazing, 20 °C
Laminated glass A Glass-plastics	Windscreen	Any thick- ness	9	8.5	—
Plastic glazing	Windscreen	Any thick- ness	—	8.5	8.5
Laminated glass B	Windscreen of road vehicle less than 40 km/h in maximum speed and other road vehicles	Any thick- ness	—	—	9
Laminated glass A Glass-plastics	Window other than windscreen	Any thick- ness	—	—	9
Laminated glass B	Window other than windscreen	$t \leq 5.5$	—	—	5
		$5.5 < t \leq 6.5$	—	—	6
		$6.5 < t$	—	—	7
Toughened glass	Window other than windscreen and windscreen of road vehicle less than 40 km/h in maximum speed and other road vehicles	Any thick- ness	—	—	2
Plastic glazing	Window other than windscreen and windscreen of road vehicle less than 40 km/h in maximum speed and other road vehicles	< 3	—	2	2
		4	—	3	3
		5	—	4	4
		6 >	—	5	5
For plastic glazing used for windows other than the windscreen and for the windscreen of large size special road vehicles having a median value of specimen nominal thickness between 3 mm to 6 mm, the drop height shall be determined by interpolation.					

- 4) For laminated glass and glass-plastics used for the windscreen, examine whether the steel ball has penetrated through the specimen, and when no tear is found in the interlayer, weigh the gross mass of the fragments detached from the side remote from impact.

For laminated glass used for other windows than the windscreen, examine whether the steel ball has penetrated through the specimen, and when no tear is found in the interlayer, measure the exposed area where fragments have fallen off

as well as area of separation. For toughened glass, examine whether the specimen has broken. For plastic glazing, examine whether the steel ball has penetrated through the specimen.

5.5 Penetration resistance test

The penetration resistance test shall be as follows.

- a) **Purpose** Determination of whether laminated glass A and glass-plastics used for the windscreen have a certain minimum penetration resistance.
- b) **Specimens** Six flat specimens of laminated glass or glass-plastics approximately 300 mm × 300 mm in dimensions manufactured in the same way as the product or six flat specimens of laminated glass or glass-plastics of the said dimensions cut out from the product.

For curved laminated glass and glass-plastics, specimens approximately 300 mm × 300 mm in dimensions cut out from the flattest part of the product may be used.

- c) **Apparatus and instrument used** The apparatus and instrument used shall be as follows.
 - 1) **Steel ball**, 2 260 g ± 20 g in mass, approximately 82 mm in diameter, with smooth surface.
 - 2) **Ball dropping equipment**, capable of dropping the steel ball freely from a minimum height of 4 m.
 - 3) **Supporting fixture**, a steel frame shown in Figure 3.
- d) **Procedure** The procedure shall be as follows.
 - 1) Condition the specimen for at least 4 h immediately preceding the test in a room at a temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
 - 2) Place the specimen in the horizontally held fixture so that the surface of the specimen which represents the inside face of the safety glass when mounted on the vehicle faces upwards.
 - 3) Allow to drop the steel ball in standstill condition with no application of external force from a height of 4 m onto the centre of the specimen. The point of impact shall be within 25 mm of the geometric centre of the specimen. The ball shall be allowed to make only one impact on one specimen.
 - 4) Examine if the ball completely penetrates through the specimen within 5 s after the impact.

5.6 Head-form (human head manikin) impact test

The head-form impact test (hereafter referred to as the head-form test) shall be as follows.

- a) **Purpose** Determination of the degree of penetration resistance ¹⁾ of laminated glass A, glass-plastics and plastic glazing against impact made by a head-form weight, and confirmation of whether the interlayer or plastics has sufficient adhe-

sion.

The test on zone-toughened glass is made to determine whether the impact to head is excessive or not.

Note ¹⁾ Ability of the product to prevent head from penetrating the windscreen in the event of collision accident. The aim of the product design is to minimise laceration in such accidents.

- b) **Specimens** For laminated glass A, glass-plastics and zone-toughened glass used for the windscreen, six flat or curved test pieces approximately 1 100 mm × 500 mm in dimensions manufactured in the same way as the product, or four whole products.

For plastic glazing used for the windscreen, six whole products.

For plastic glazing used for other windows than the windscreen, six flat or curved test pieces approximately 1 170 mm × 570 mm in dimensions manufactured in the same way as the product according to Table 3, or six whole products.

- c) **Apparatus and instrument used** The apparatus and instrument used shall be as follows.

1) **Head-form test without deceleration measurement**

- 1.1) **Head-form**, 10 kg ± 0.2 kg in mass, having a structure shown in Figure 4.

Unit: mm

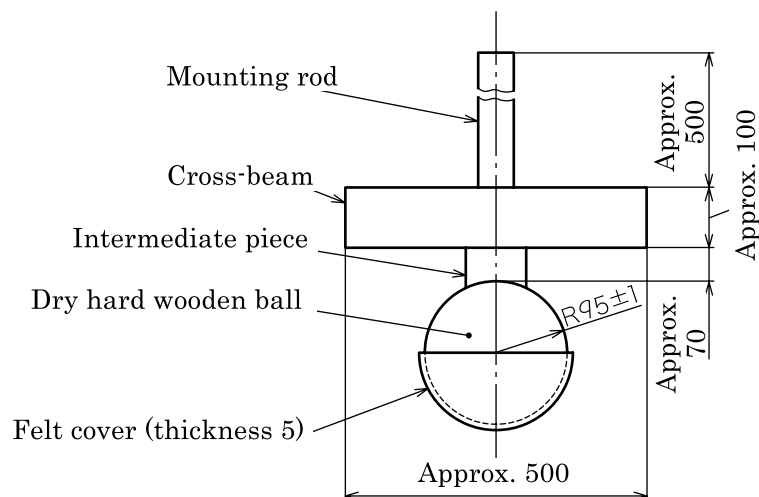


Figure 4 Head-form apparatus and instruments used for test without deceleration measurement

1.2) **Dropping equipment**, capable of dropping the head-form freely from a height specified in Table 5.

1.3) **Specimen supporting fixture**

1.3.1) In a test using a test piece as a specimen, the supporting fixture shall be composed of two steel frames as shown in Figure 5, of which the upper frame shall be pressed against the lower frame by at least eight bolts. The distance between the specimen and the floor surface shall be 300 mm or over.

Unit: mm

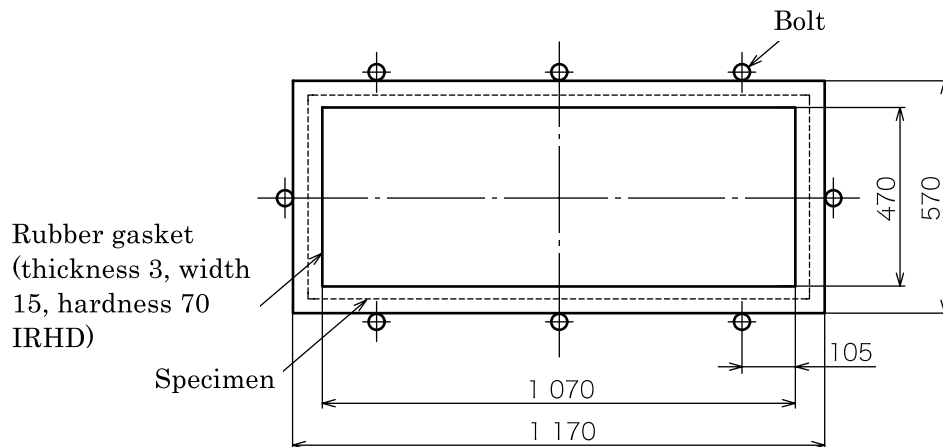


Figure 5 Example of fastening with bolts

1.3.2) In a test using a whole product as a specimen, the supporting fixture shall consist of a wooden or resin piece with interposed stripes of rubber of hardness 70 IRHD ²⁾ and thickness of 3 mm, the width of contact with the specimen being about 15 mm. The fixture shall be placed on a rigid floor with a sheet of rubber of hardness 70 IRHD and thickness of 3 mm placed under it.

NOTE IRHD : International Rubber Hardness Degrees specified in **JIS K 6253-2**.

Note ²⁾ Equivalent to durometer hardness of A70 in **JIS K 6253-3**.

2) **Head-form test with deceleration measurement**

2.1) **Head-form**, 10 kg $\pm$ 0.2 kg in mass, having a structure as shown in Figure 6 and composed of parts as listed in Table 3.

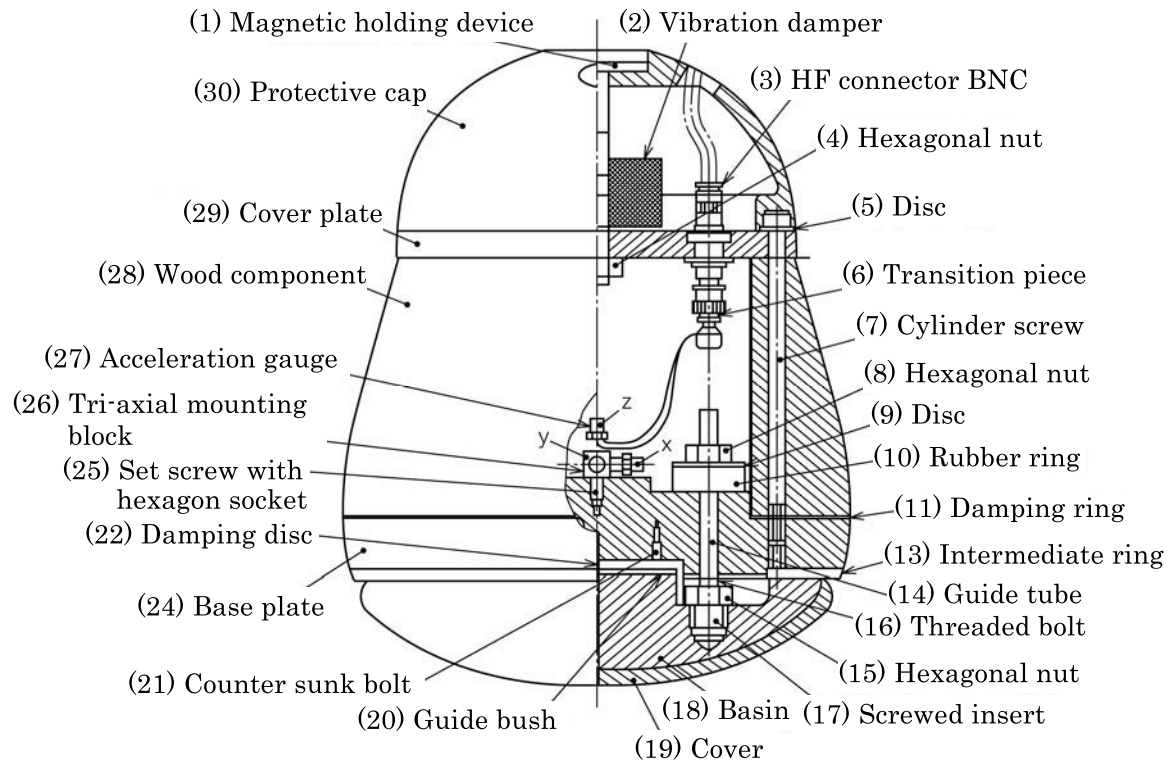


Figure 6 Head-form apparatus and instruments used for test with deceleration measurement

Table 3 List of components for the head-form

Position no.	Number of pieces	Standard notation	Material	Remarks
1	1	Magnetic holding device	Steel	—
2	1	Vibration damper	Rubber/steel	Diameter : 50 mm Thickness : 30 mm Thread : M10
3 ^{a)}	4	HF connector BNC	—	Coupler-coupler
4	1	Hexagonal nut	—	—
5	6	Disc	—	—
6 ^{a)}	3	Transition piece	—	—
7	6	Cylinder screw	—	Torque about 12 Nm
8	3	Hexagonal nut	—	Torque about 4 Nm
9	3	Disc	Steel	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	—		—	—

Table 3 (concluded)

Position no.	Number of pieces	Standard notation	Material	Remarks
13	1	Intermediate ring	Butadiene-rubber, hardness about 60 IRHD	Hole diameter : 129 mm Outer diameter : 192 mm Thickness : about 6 mm
14	3	Guide tube	Polytetrafluoroethylene (PTFE)	Inner diameter : 8 mm Outer diameter : 10 mm Length : 40 mm
15	3	Hexagonal nut	—	—
16	3	Threaded bolt	—	—
17	3	Screwed insert	Cast alloy	Dimensions M8x12
18	1	Basin	Polyamide 12	—
19	1	Cover	Butadiene-rubber	Thickness : 6 mm Rib on one side
20	1	Guide bush	Steel	—
21	4	Counter sunk screw	—	—
22	1	Damping disc	Gasket paper	Diameter : 65 mm Thickness : 0.5 mm
23	—	—	—	—
24	1	Base plate	Steel	—
25	1	Set screw with hexagonal socket	Class of strength 45H	—
26	1	Tri-axial mounting block	—	—
27	3	Acceleration gauge	—	—
28	1	Wood component	Hornbeam, glued in layers	—
29	1	Cover plate	Alloy	—
30	1	Protective cap	Polyamide 12	—
Note ^{a)} These components are unnecessary in case of wireless data transmission. In this case, other components for data transmission are installed in the head-form.				

2.2) **Dropping device**, structured as shown in Figure 7.

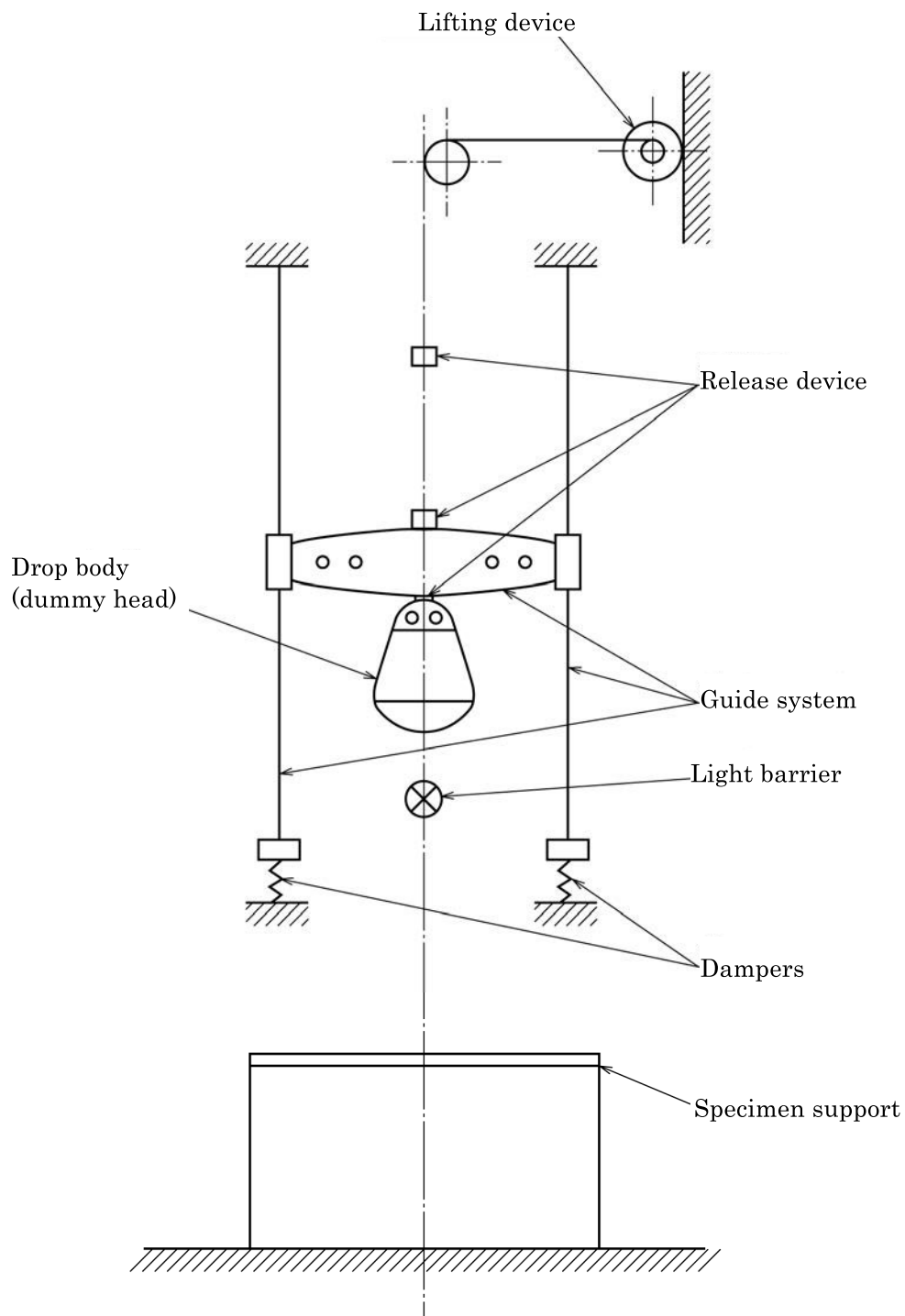


Figure 7 Head-form apparatus used for test with deceleration measurement

2.2.1) **Adjustment and calibration** Before performing the head-form test, a dummy head is fixed to the cross arm of the guide system and moved to the required drop height by means of a lifting device. To start the drop test the cross arm

with the dummy head is released. After passing the height-adjustable light barrier the dummy head is released from the cross arm, the cross arm's fall is dampened and the dummy head drops onto the sample. Instead of the data transmission via cables, wireless data transmission (e.g. radio transmission) may be used. In this case, the guide system can be omitted because of no risk of obstruction of the free vertical drop by any cables.

No impulse may be given to the dummy head by the drop appliance or by the data-transmission cables (if applicable), so that it is accelerated only by gravity and drops freely and vertically.

- 2.2.2) **Equipment to calibrate the dummy head** Drop appliance which shall allow drop heights between 50 mm and 254 mm to be adjusted exactly to within 1 mm. A guide system is not necessary for these small drop heights. Impact plate shall be made of steel, and 600 mm × 600 mm in dimensions and at least 50 mm in thickness. The impact surface shall be ground to obtain the following.

Average surface roughness $Ra < 0.5 \mu\text{m}$ and flatness tolerance $t = 0.05 \text{ mm}$.

- 2.2.3) **Calibration and adjustment of dummy head** Before each test series and no later than each 50 tests within a series, the dummy head shall be calibrated and adjusted if necessary. The impact plate shall be clean and dry and shall lie on a concrete base without being fixed during the calibration procedure. Alternatively, the impact plate may be placed in a massive supporting device if this device is connected to a concrete foundation. The dummy head is allowed to hit the impact plate vertically. The drop heights (measured from the lowest point of the dummy head to the surface of the impact plate) are 50 mm, 100 mm, 150 mm and 254 mm. The deceleration curves shall be recorded.

The greatest deceleration a_z from the various drop heights on the z-axis shall lie within the limits given in Table 4.

The deceleration curves shall be based on a uni-modal oscillation. 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.

Table 4 Greatest deceleration a_z on the z-axis which shall be reached for calibration, depending on the drop height

Drop height mm	Greatest deceleration a_z , expressed in multiples of g (acceleration due to gravity)
50	82 ± 8
100	128 ± 8
150	167 ± 10
254	227 ± 14

- 3) **Specimen supporting fixture**, the same as specified for the test without deceleration measurement.

d) **Procedure** The procedure shall be as follows.

- 1) In the case of laminated glass A, glass-plastics and plastic glazing, condition the specimen for at least 4 h immediately preceding the test in a room maintained at a temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

2) **Supporting of specimen**

- 2.1) In a test using a test piece as a specimen, place the specimen on a horizontally placed lower frame so that the periphery of the specimen is evenly supported by the rubber gasket on the lower frame, and place the upper frame on it that has also a rubber gasket.

Make sure that the face of the specimen representing the inside face of the safety glass when mounted on the vehicle faces upwards. Fasten the upper and lower frames together with bolts or by oil hydraulic means so that the specimen will not be dislocated from the frame by the impact of the head-form.

- 2.2) In a test using a whole product as a specimen, place the specimen on the fixture ensuring about 15 mm contact width with the fixture all around its periphery.

Make sure that the face of the specimen representing the inside face of the safety glass when mounted on the vehicle faces upwards.

- 3) Allow to drop the head-form in standstill condition with no application of external force from the height specified in Table 5 onto the centre of the specimen surface. The point of impact shall be within 40 mm of the geometric centre of the specimen. The head-form shall be allowed to make only one impact on one specimen.