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Road vehicles — Tests for rigid plastic safety glazing materials

Véhicules routiers — Essais pour les vitrages de sécurité rigides en matières plastiques

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 15082 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 11, *Safety glazing materials*.

Annexes A, B, D, E of this International Standard are for information only.

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Road vehicles — Tests for rigid plastic safety glazing materials

1 Scope

This International Standard specifies all test methods relating to the safety requirements for rigid plastic safety glazing materials in a road vehicle, regardless of the type of plastic of which they are composed.

NOTE Plastic safety glazing materials are classified as rigid or flexible by use of the test described in Annex A.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 3536:1999, *Road vehicles — Safety glazing materials — Vocabulary.*

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

ISO 3795:1989 *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 3917:1999, *Road vehicles — Safety glazing materials — Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering.*

ISO 4892-2:1994, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources.*

ISO 20566:2006, *Paint and varnishes – Determination of the scratch resistance of a coating system using a laboratory car-wash*

ISO 5725-2 :2002, *Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method (ISO 5725-2:1994 including Technical Corrigendum 1:2002)*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 3536 apply.

4 Test conditions

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

— ambient temperature: 20 °C ± 5 °C;

— atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar);

— relative humidity: (60 ± 20) %.

5 Conditioning of test specimens

Unless otherwise specified, all test specimens to be tested shall be conditioned prior to testing under the following conditions and for the following periods of time:

— ambient temperature: 23 °C ± 2 °C for at least 48 h;

— ambient relative humidity: (50 ± 5) % for at least 48 h;

— low temperature: –18 °C ± 2 °C for at least 24 h.

6 Application of tests

For certain types of safety glazing material, it is not necessary to carry out all the tests specified in this International Standard.

7 Optical properties test

Test plastic safety glazing materials in accordance with ISO 3538.

8 Head-form/fragmentation test

8.1 Principle

Determine the fragmentation characteristics of plastic safety glazing materials at ambient temperature.

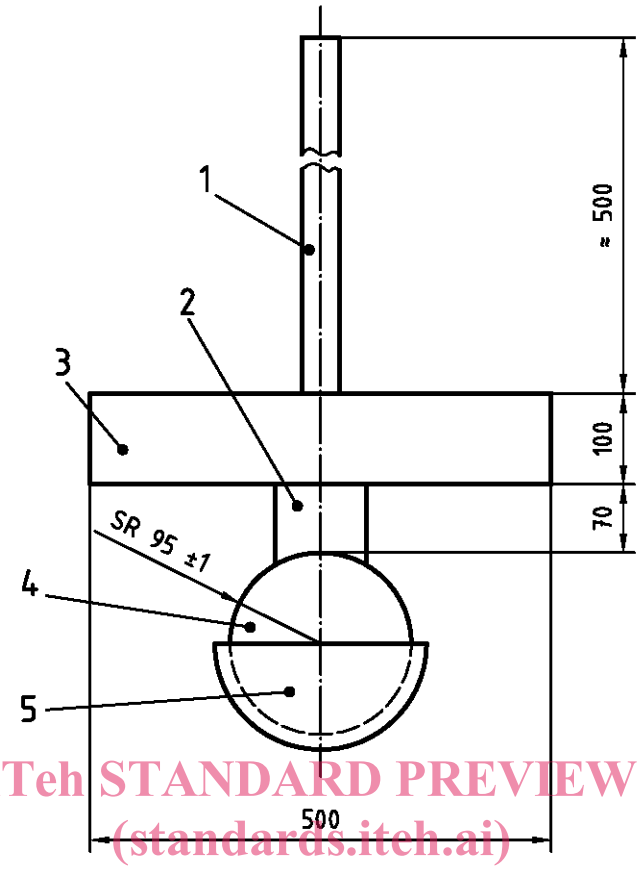
8.2 Apparatus

8.2.1 Head-form weight, with a spherical or semi-spherical head made of laminated hardwood covered with replaceable felt and with or without a cross- beam made of wood. Between the spherical part and the cross-beam, there is a neck shaped intermediate piece and on the other side of the cross-beam, a mounting rod.

The dimensions shall be in accordance with Figure 1.

The total mass of the apparatus shall be 10 kg ± 0,2 kg.

Dimensions in millimetres



Key

1 Mounting rod
2 Intermediate piece
3 Cross-beam (optional)
4 Head
5 Felt cover 5 mm thick

Figure 1 — Head-form weight

8.2.2 Means for dropping the head-form weight freely from a height to be specified, or means for giving the weight a velocity equivalent to that obtained by the free fall.

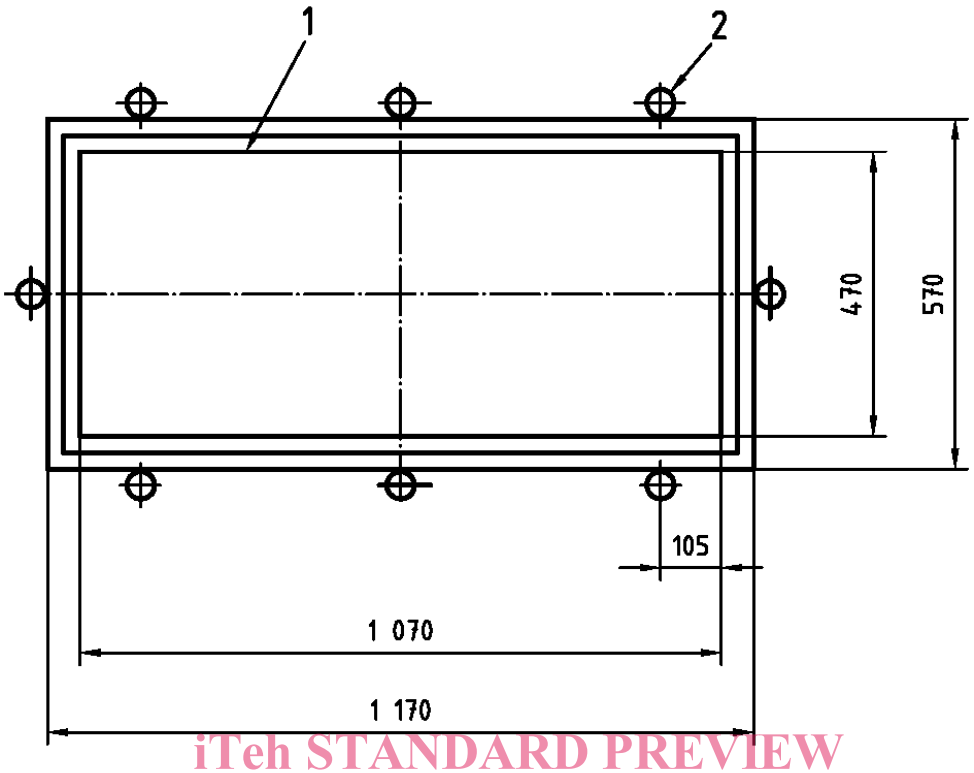
When a device to project the head-form weight is used, the tolerance on velocity shall be ± 1 % of the velocity equivalent to that obtained by the free fall.

8.2.3 Supporting fixture, as shown in Figure 2, for testing flat test specimens. The fixture is composed of two steel frames, with 50 mm wide machined edges, fitting one over the other and faced with rubber gaskets about 3 mm thick, and 15 mm ± 1 mm wide, of hardness 70 IRHD, measured in accordance with ISO 48. The upper frame is pressed against the lower frame by at least eight bolts; the minimum recommended torque for M20 bolts is 30 Nm. Alternatively, other pressing techniques may be used, e.g. hydraulic or pneumatic pressing. (Reference to Paragraph 8.4)

8.3 Test specimens

Test specimens shall be flat rectangles with length 1 100 mm $^{+5}_{-2}$ mm and width 500 mm $^{+5}_{-2}$ mm.

Dimensions in millimetres



Key

1 Rubber gasket
2 Bolt

Figure 2 — Support for head-form tests

8.4 Procedure

Place a conditioned test specimen in the supporting fixture (Figure 2); the torque on the bolts, or the amount of hydraulic or pneumatic pressure, shall ensure that the movement of the test specimen during the test will not exceed 2 mm. The plane of the test specimen shall be substantially perpendicular to the incident direction of the head-form weight.

The head-form weight shall strike the test specimen, from a height to be specified, within 40 mm of its centre on that face which represents the inside face of the plastic safety glazing material when mounted on the vehicle, and shall be allowed to make only one impact.

The felt cover shall be replaced after 12 tests, or when damaged.

8.5 Expression of results

Evaluate the fracture characteristics of the plastic safety glazing material by recording whether the test specimen did not break and the head-form was supported, or the test specimen broke and the head-form was supported, or the test specimen broke and the head-form was not supported. Record the drop height for each impact test.

In the event of fracture, evaluate the plastic safety glazing material by recording the smallest angle between two adjacent sides of resulting fragments and the area, longest dimension, and weight of the largest fragment. Record this data for the fragments remaining in the supporting fixture and for those that are dislodged from the supporting fixture.

9 Head-form test with deceleration measurement

9.1 Principle

Assessment of the minimum strength and fragmentation characteristics of plastic safety glazing materials under impact from a blunt, bulky object at ambient temperature. The danger of skull-brain-injuries is assessed by simultaneous determination of the HIC (head injury criterion)-values.

Tests can be performed on flat specimens or on complete panes.

9.2 Test conditions

Unless otherwise specified, the test shall be carried out under the following conditions:

— ambient temperature: 20°C ± 5°C;

— atmospheric pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar);

— relative humidity: (60 ± 20) %.

9.3 Conditioning of test pieces

Unless otherwise specified, the test pieces to be tested shall be conditioned prior to testing under the following conditions and for the following periods of time:

— ambient temperature: 23°C ± 2°C for at least 48 h;

— ambient relative humidity: (50 ± 5) % for at least 48 h

9.4 Apparatus

To perform the head-form test with deceleration measurement, a test apparatus according to Figure 3 can be used. The head-form (Paragraph 9.4.1 and Figure 4) 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 head-form is released. After passing the height-adjustable light barrier the head-form is released from the cross arm, the cross arm's fall is dampened and the head-form drops onto the test piece. 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.

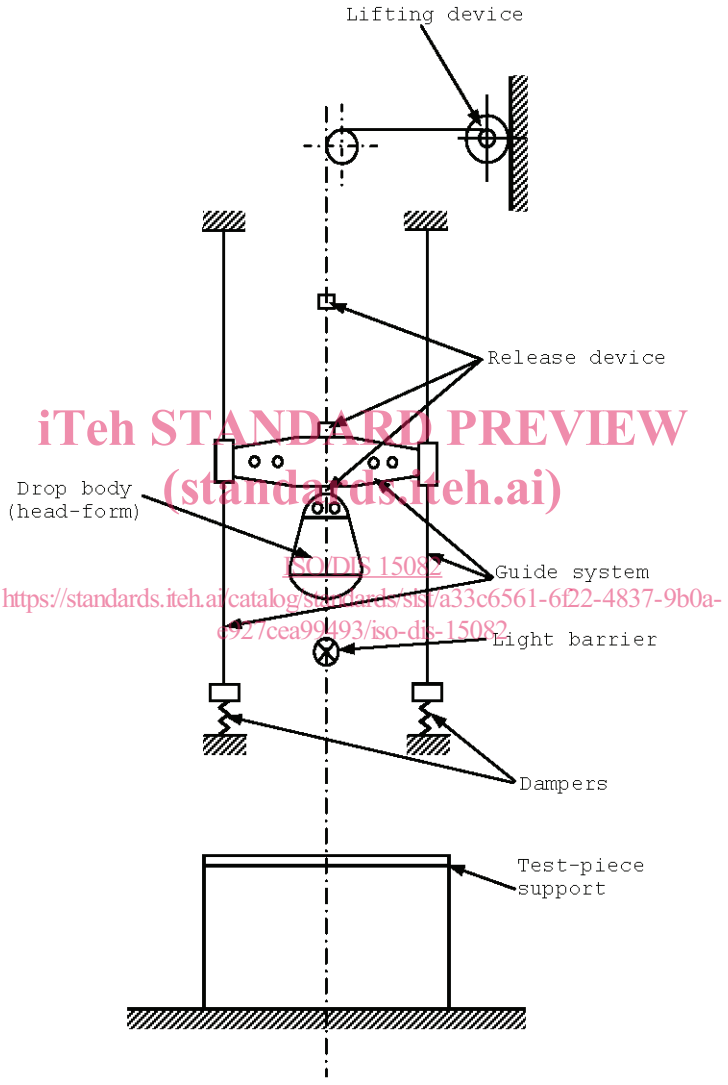


Figure 3 — Principal sketch of a test apparatus for the head-form test with deceleration measurement

9.4.1 Head-form weight: head-form (as shown in Figure 4 for data transmission via co-axial (BNC) cables) with total mass of 10.0 kg +0.2/-0.0 kg, which allows the simultaneous determination of HIC-values. The components of the head-form according to Figure 4 are listed in Table 1. In the middle of the base plate (24) the tri-axial mounting block (26) is mounted in the centre of gravity to hold the acceleration gauges (27). The acceleration gauges must be arranged vertically to each other.

The basin (18) and cover (19) situated under the base plate (24) share, to a great extent, the elastic properties of the human skull. The elastic properties of the head-form on impact are determined by the hardness and the thickness of the intermediate ring (13) and the basin.

If wireless data transmission is used instead of transmission via co-axial cables, it must be ensured that those electronic components additionally installed in the head-form do not influence mass, gravity centre point and spring force of the head-form. Those electronic components must 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 head-form. 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.

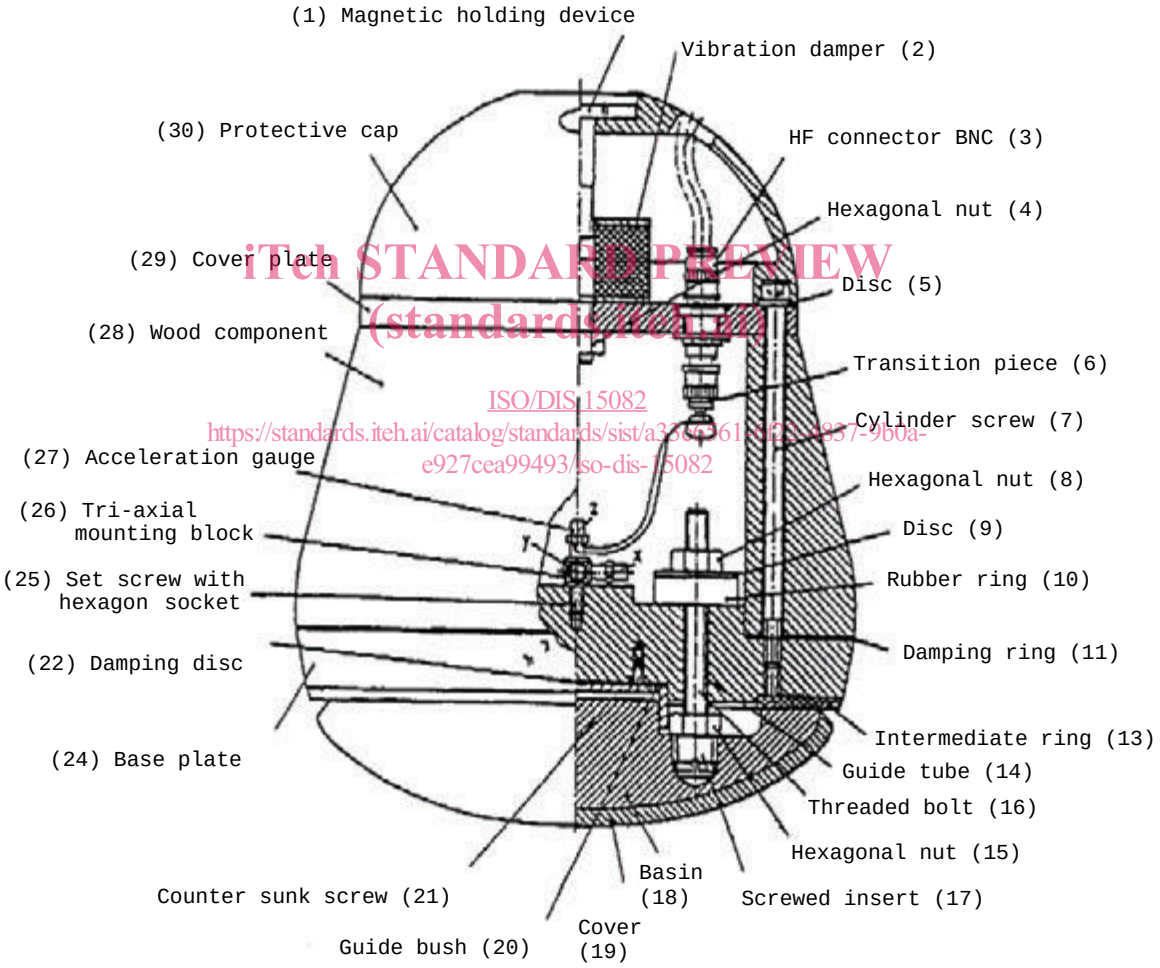


Figure 4 — 10 kg head-form

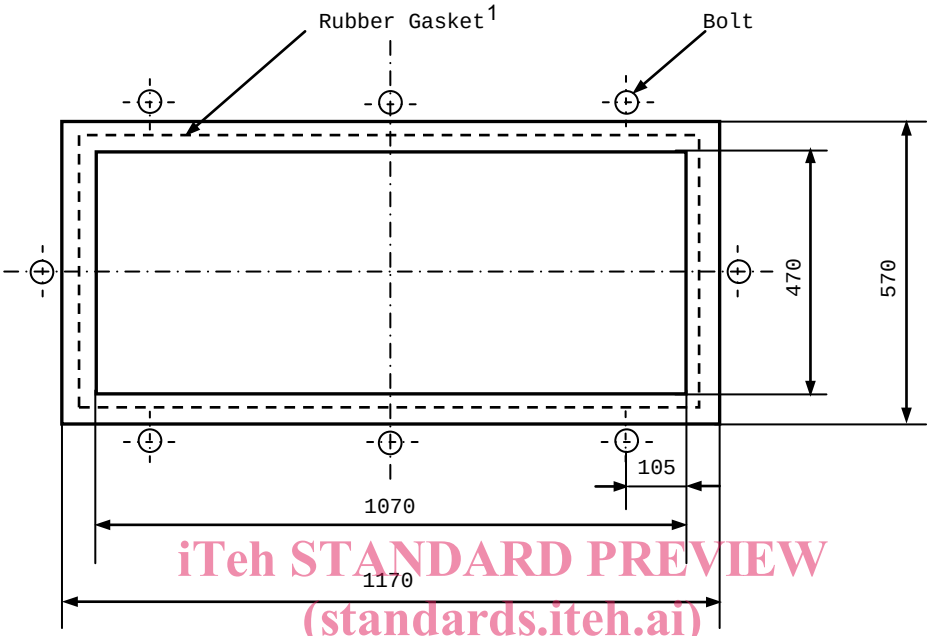
9.4.2 Measuring device – for recording and evaluation of the measured deceleration curves $a_x(t)$, $a_y(t)$ and $a_z(t)$, transmitted from the head-form acceleration gauges via cables or wireless: acceleration gauges, measuring and recording instruments according to ISO 6487, channel-amplitude class CAC 5000 m/s² and channel-frequency class CFC 1000Hz.

Table 1: List of components for the 10 kg head-form shown in Figure 4

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 [1]	4	HF connector BNC	-	Coupler-coupler (EN 122120)
4	1	Hexagonal nut ISO10511-M10-05	-	-
5	6	Disc ISO7090-6-200HV	-	-
6 [1]	3	Transition piece Pos.No. 3 – Pos.No. 27	-	-
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 9.5)
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 (ISO 48)	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 (ISO 48)	Hole diameter: 129 mm Outer diameter: 192 mm Thickness: about 6 mm (ref. paragraph 9.5)
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 DIN976–1–M8x90–B–8.8	-	-
17	3	Screwed insert	Cast alloy EN1982-CuZn39Pb1Al-C-GP	Dimensions M8 x 12 (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 9.4.2
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)	-

1 These components are unnecessary in case of wireless data transmission. In this case other components for data transmission are installed in the head-form (e.g. radio transmitter), ref. Paragraph 9.4.1.

9.4.3 Supporting fixture for testing flat test specimens, as shown in Figure 5. The fixture is composed of two steel frames, with machined edges, 50 mm wide, fitting one over the other and faced with rubber gaskets about 3 mm thick, and 50 mm +1/-0 mm wide, of hardness 70 IRHD, determined in accordance with ISO 48. The upper frame is pressed against the lower frame by at least eight bolts; the minimum recommended torque for M20 bolts is 30 Nm. Alternatively, other pressing techniques may be used, e.g. hydraulic or pneumatic pressing (ref. Paragraph 9.7).



Dimensions in millimetres

Figure 5 — Support for tests on flat specimens

9.4.4 Supporting fixture for testing complete panes: The support shall consist of a rigid piece corresponding to the shape of the pane so that the head-form 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, determined in accordance with ISO 48, and thickness of about 3 mm, the width of contact over the whole perimeter being about 15 mm.

9.4.5 Equipment to calibrate the head-form

9.4.5.1 Drop appliance which must 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.

9.4.5.2 Impact plate made of steel, dimensions 600 mm x 600 mm, minimum thickness 50 mm, flatness tolerance t = 0.05 mm, determined in accordance with ISO 1101.

9.5 Calibration procedure and adjustment of the head-form

Before each test series and no later than each 50 tests within a series, the head-form must be calibrated and adjusted if necessary.

The impact plate must be clean and dry and must lie non-positively on a concrete base 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 head-form is allowed to hit the impact plate vertically. The drop heights (measured from the lowest point of the head-form to the surface of the impact plate) are 50, 100, 150 and 254 mm. The deceleration curves shall be recorded.

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[1] Dashed line indicates centre line of rubber strip, centrally on support edge

The greatest deceleration a_z from the various drop heights on the z-axis must lie within the limits given in Table 2.

Table 2: **Greatest deceleration a_z on the z-axis which must be reached for calibration, depending on the drop height.**

Drop height mm	Greatest deceleration[2] a_z m/s²
50	(82 ± 8) g
100	(128 ± 8) g
150	(167 ± 10) g
254	(227 ± 14) g

The deceleration curves must be based on a uni-modal oscillation. The deceleration curve of the drop height of 254 mm must run at least 1.5 ms and at most 2 ms over 100 g.

If the requirements given above are not met, the elastic properties of the head-form must be adjusted by varying the thickness of the intermediate ring (13) of the base plate (24). Corrections can be carried out by adjusting the three self-locking hexagonal nuts (8) on the threaded bolts (16) by which the basin (18) is fixed to the base plate (24). The rubber rings (10) under the hexagonal nuts (8) must not be brittle or cracked.

The cover (19) of the impact surface and the intermediate ring (13) must be replaced if damaged; especially they must always be replaced simultaneously if the head-form can no longer be adjusted.

9.6 Test Pieces: Flat test specimens (1170 mm +0/-2 mm x 570 mm +0/-2 mm) or complete panes shall be subjected to testing.

9.7 Test Procedure: In case of flat test specimens, fix the specimen in the supporting frames (Paragraph 9.4.3). In case of tests on complete panes, clamp the pane to a support which has a shape corresponding to the pane (Paragraph 9.4.4).

The torque on the bolts respectively the amount of hydraulic or pneumatic pressure shall ensure that the movement of an edge of the test piece during the test will not exceed 2 mm.

The plane of the test piece shall be substantially perpendicular to the incident direction of the weight. The head-form weight shall strike the test piece within 40 mm of its geometric centre on that face which represents the inward face of the safety glazing pane when the latter is mounted on the vehicle, and shall be allowed to make only one impact.

In case of data transmission via co-axial cables, the head-form is fixed to the cross arm of the guide system (ref. Figure3) and moved to the required drop height[3] which depends on the desired impact velocity. In case of tests on complete panes, drop heights between 1.5 m and 3 m are used if not specified otherwise. The cross arm which carries the head-form is released. After passing the height-adjustable light barrier the head-form is released from the cross arm, the cross arm's drop is dampened and the head-form drops onto the test piece.

In case of wireless data transmission, the guide system can be omitted. The head-form is fixed directly to the upper release device of the lifting unit and moved to the required drop height. The head-form is released and drops freely onto the test piece.

No impulse may be given to the head-form 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.

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[2] The values of the greatest deceleration a_z are maximum values of the deceleration curves $a_z(t)$, expressed in multiples of g (acceleration due to gravity: g = 9.81 m/s²).

[3] The drop height is the distance between the lowest point of the head-form and the upper surface of the test piece.