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Test methods of safety glazing materials used on road vehicles - Part 1: Mechanical properties tests

汽车安全玻璃试验方法 第 1 部分：力学性能试验

(ISO 3537:2015, Road vehicles - Safety glazing materials - Mechanical tests, MOD)

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Test methods of safety glazing materials used on road vehicles - Part 1: Mechanical properties tests

1 Scope

This Part of GB/T 5137 specifies the test methods for impact resistance test, penetration resistance test, abrasion resistance test, fragmentation test, head-form impact test, cross-cut test, and flexibility and folding test of safety glazing materials used on road vehicles.

This Part applies to the tests of safety glazing materials used on road vehicles.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

QC/T 1119 Road vehicles - Glazing materials - Terminology (QC/T 1119-2019, ISO 3536:2016, MOD)

ISO 6487 Road vehicles - Measurement techniques in impact tests - Instrumentation

3 Terms and definitions

For the purposes of this document, the terms and definitions given in QC/T 1119 apply.

4 Test conditions

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

a) Ambient temperature: 20 °C±5 °C;

b) Atmospheric pressure: 8.60×10^4 Pa~1.06×10^5 Pa;

c) Relative humidity: 40%~80%.

the sample in the fixture, it shall be clamped to ensure that the movement of the sample during test shall not exceed 2 mm at any point along the inside periphery of the fixture. Impact height refers to the distance from the lower surface of the steel ball to the upper surface of the sample.

The ball shall strike the face of the sample which represents the outside face of the safety glazing material when mounted on the vehicle. The ball shall be allowed to make only one impact.

After the impact, evaluate the damage form and degree of the sample. If there is a requirement for the mass of the detached fragments on the reverse side of the impact surface, it shall weigh and record the total mass of the detached fragments.

6 Penetration resistance test (2260 g steel ball test)

6.1 Test purpose

Evaluation of the penetration resistance of the safety glazing material.

6.2 Test devices

6.2.1 Steel ball

Hardened steel ball, with a mass of 2260 g±20 g and a diameter of approximately 82 mm.

6.2.2 Means for dropping

Means for dropping the ball freely from a height to be specified. The impact point of the steel ball shall be within a circle with a radius of 25 mm at the center of the sample.

6.2.3 Sample supporting fixture

Same as 5.2.3.

6.3 Sample

USE the special flat test piece prepared under the same material and process conditions as the product or the test piece cut from the flattest part of the product AS the sample. The size is 300^{+10}_{0} mm×300^{+10}_{0} mm. When applicable, the product can also be a sample.

Before the test, the laminated glass test sample shall be placed at a temperature of 20 °C±5 °C and a relative humidity of 40%~80% for at least 4 h. The sample of plastic-glass composite material shall be placed at a temperature

of 23 °C±2 °C and a relative humidity of 45%~55% for at least 48 h. The sample of plastic-glass composite material shall be tested within 30 s of leaving the placement condition.

6.4 Test procedure

PLACE the sample in the supporting fixture as described in 5.2.3. The impact plane of the sample shall be perpendicular, within 3°, to the incident direction of the ball. In the case of curved samples, it shall make sure that the sample can fully contact the edge of the supporting fixture. When necessary to retain the sample in the fixture, it shall be clamped to ensure that the movement of the sample during test shall not exceed 2 mm at any point along the inside periphery of the fixture. The impact height is 4000 mm; the tolerance range is 0 mm~25 mm, which refers to the distance from the lower surface of the steel ball to the upper surface of the sample.

The ball shall strike the face of the sample which represents the internal face of the safety glazing material when mounted on the vehicle. The ball shall be allowed to make only one impact.

After the impact, evaluate whether the steel ball penetrates the sample within 5 s.

7 Abrasion resistance test

7.1 Test purpose

Determination of whether the safety glazing material has a certain minimum resistance to abrasion at ambient temperature.

7.2 Test devices

7.2.1 Abrading instrument, shown diagrammatically in Figure 2, and consisting of the following:

a) A horizontal turntable and center clamp which revolves counter-clockwise. The turntable shall rotate steadily and be kept on a horizontal surface. The runout of the end face at 1.6 mm from the periphery of the turntable shall be no more than ±0.05 mm. Its speed is 55 r/min~75 r/min.

b) Two weighted parallel arms, each carrying a special abrasive wheel freely rotating on a ball bearing horizontal spindle. The distance between the inner surfaces of the two abrasive wheels is (52.4±1.0)mm (corresponding to the centerline distance 65.1 mm between the two abrasive wheels). The horizontal offset distance between the centerline of the two abrasive wheel spindles and the axis of the rotary table is (19.05±0.30)mm, as shown in

7 - Filter;

8 - Photodetector;

9 - Light trap;

10 - Reflectance standard.

Figure 3 -- Diagram of hazemeter

Calibrate the hazemeter before the initial measurement of the haze with no sample present and verify that the reading of the hazemeter is zero. The whole apparatus shall be checked at regular intervals by means of calibration standards of defined haze.

If haze measurements are made using equipment or methods differing from the above, the results shall be corrected in order to agree with those obtained by the apparatus described above.

7.3 Ambient conditions for test

The test shall be conducted under the following ambient conditions:

a) Ambient temperature: 23 °C±2 °C;

b) Atmospheric pressure: 8.60×10^4 Pa~1.06×10^5 Pa;

c) Relative humidity: 45%~55%.

7.4 Sample

USE a square special flat test piece with a side length of 100 mm prepared under the same material and process conditions as the product or a test piece cut from a flat product AS a sample. The two surfaces shall be flat and parallel enough; if necessary, drill a fixed hole with a diameter of about 7 mm±0.5 mm in the center. When both the inner and outer surfaces need to be tested for abrasion, the number of samples is doubled. For sandwich products with a thickness of more than 20 mm, only the outer material may be tested.

Before the abrasion test, the sample shall be placed at a temperature of 23 °C±2 °C and a relative humidity of 45%~55% for at least 48 h. The test shall be started within 5 min of leaving the environment. The abrasive wheels, when not in use, shall also be stored under the above conditions.

7.5 Test procedure

7.5.1 Determination of test surface and number of grinding revolutions

START the abraser and subject the sample to abrasion for a selected number of cycles. For outer surfaces, subject the sample to alternatively 100 cycles or 500 cycles or 1000 cycles (depending on the specification of the material to be tested). For inner surfaces, subject the sample to 100 cycles, using new samples.

After abrasion, handle the samples by their edges to prevent contamination of their surfaces. Using a soft bristle, anti-static brush, lightly brush off any debris adhered to the surface of the samples. Or clean the samples following the procedure described in 7.5.2.

7.5.5 Final haze measurement and calculation

PLACE the abraded sample with the abraded side facing the entrance port of the integrating sphere. MEASURE the final haze of the abraded track. Each sample is measured at least 4 equally spaced points along the abrasion track. TAKE the average. If the abrasion track is not homogeneous, up to 16 equally spaced points along the track can be measured. TAKE the average. The angle between the normal to the surface of the sample and the axis of the beam shall not exceed 8°. The haze measurement and calculation methods are the same as 7.5.3.

7.5.6 Calculation of haze caused by abrasion

The initial haze value is subtracted from the final haze value, to obtain the haze value caused by abrasion.

8 Fragmentation test

8.1 Test purpose

Assessment of the nature of fragmentation resulting from the fracture of tempered glass.

8.2 Test devices

Instrument capable of causing the glazing material to break from the impacted surface, such as a hammer with a pointed head or other equivalent tools. The radius of curvature of the pointed head shall be 0.2 mm±0.05 mm.

8.3 Sample

USE the product or special test piece as the sample.

8.4 Impact point

c - Impact point 2.

Figure 4 -- Diagram of location of impact points

8.5 Test procedure

8.5.1 The sample shall not be rigidly fixed; but measures shall be taken to ensure that the fragments do not fall or splash after breaking. It is possible to fix the sample tightly on top of second sample of the same shape and dimensions by means of transparent adhesive tape around the periphery.

8.5.2 IMPACT the impact point of the sample to break it.

8.5.3 Within 10 s to 3 min after the impact, use the photographic paper method or other effective measures to complete the retention record of the fragmentation. Retention measures shall ensure the counting accuracy and the accurate identification of the maximum area of fragments.

8.5.4 The area of 20 mm around the sample and 75 mm radius around the impact point is the non-evaluation area. In the evaluation area, count the minimum number of fragments within the range of 50 mm×50 mm. Fragment, which extends beyond the side of the counting area, is counted as half piece. RECORD whether there are fragments with an area of more than 3 cm^2 and the length of the longest strip fragment. If the fragment exceeds the evaluation area, the area and length of the fragment in the evaluation area are measured only. For the strip fragments, also record whether their tips are blade-shaped. If it enters the 20 mm area of the sample edge, is the angle between itself or its extension and the edge of the sample greater than 45°.

9 Head-form impact test

9.1 Head-form impact test without deceleration measurement

9.1.1 Test devices

9.1.1.1 Head-form

Head-form, a spherical or semi-spherical head made of laminated hard wood covered with replaceable felt cover and a cross-beam made of wood. The thickness of the felt cap is 5 mm±1 mm. 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 total mass of the head-form is 10 kg±0.2 kg. Its dimensions are shown in Figure 5.

9.2 Head-form impact test with deceleration measurement

9.2.1 Test purpose

Evaluate the minimum strength and broken state of plastic or glass materials under the impact of large blunt objects at normal temperature; USE the calculated HIC (Head Injury Criterion) value to assess the risk of craniocerebral injury.

9.2.2 Test devices

9.2.2.1 Head-form

The total mass of the head-form is $10.0^{+0.2}_{0.0}$ kg. Its structure diagram is shown in Figure 7. In the middle of the steel base plate (21), a three-axis mounting block (24) is installed at the center of gravity, to fix the acceleration sensor (25) measuring the x, y, and z directions. The x and y direction sensors are arranged horizontally and perpendicular to each other. The z direction sensor is arranged vertically and perpendicular to the x and y direction sensors.

The nylon impact basin (17) and the butadiene rubber cover (18) are located under the steel base plate (21). By adjusting the hardness and thickness of the intermediate ring (12) and the nylon impact basin (17), adjust the elastic properties of the impact of the head-form.

Wireless transmission can be used instead of coaxial cable; but it shall be ensured that, the additionally-installed electronic components do not affect the mass, center of gravity, and elasticity of the head-form. Electronic components can only be mounted on a steel base plate (21). If necessary, mass correction can be performed; but the correction must also be on the surface of the base plate facing the cavity in the head-form.

9.2.2.2 Measuring equipment

It is used to record and evaluate the measured deceleration curves $a_x(t)$, $a_y(t)$, and $a_z(t)$. The data is obtained from the acceleration sensor of the head-form through wired or wireless transmission. The measuring and recording device shall meet the requirements of ISO 6487. The channel amplitude (CAC) is 5000 m/s^2. The channel frequency (CFC) is 1000 Hz.

9.2.2.3 Means for dropping

Means for dropping the head-form freely from a height to be specified. The impact point of the head-form must be within a circle with a radius of 40 mm at the center of the sample.

9.2.2.4 Sample supporting fixture

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