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Laminated glass

Replaced (by GB 15763.3-2009)

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Foreword

This Standard is an equivalent standard of Japanese Standard JIS R3205:1989 *Laminated glass* in technical contents; and it makes reference to ANSI Z97.1:1984 *Safety glazing materials used in buildings - Safety performance specifications and methods of test*, ISO/DIS 12543-1~12543-6:1997 *Glass in building - Laminated glass and laminated safety glass*, AS/NZS 2208:1996 *Safety glazing materials in buildings*, etc.

This Standard is the first revision of the 1988 edition. The revised contents are as follows:

ADD the laminated glass of category II on the basis of reserving the original laminated glass of categories I and III. ADD the following four indicators: visible light transmittance, visible light reflectance, moisture resistance and wind pressure resistance. Except the moisture resistance, the other three items are recommended indicators. The impact resistance is renamed falling ball impact stripping performance. The penetration resistance is renamed grape-shot bag impact performance. In the meantime, MAKE appropriate modifications to the technical requirements and test methods of some test items.

In the revised standard, the radiation resistance, heat resistance and falling ball impact stripping performance are equivalent to the Japanese Standard JIS R3205; the grape-shot bag impact test adopts the requirements of the American Standard ANSI Z97.1; the moisture resistance test is equivalent to ISO/DIS 12543-4.

The Appendixes A and B of this Standard are normative appendixes.

This Standard replaces GB 9962-1988 from the date of implementation.

This Standard was proposed by State Bureau of Building Materials Industry.

This Standard shall be under the jurisdiction of the Glass Science Research Institute of China Building Materials Academy.

Drafting organization of this Standard: Glass Science Research Institute of China Building Materials Academy.

Main drafters of this Standard: Chen Zhengke, Han Song, Wang Ruyang, Wang Le and Hu Yue.

Laminated glass

1 Scope

This Standard specifies the classification, requirements and test methods for laminated glass.

This Standard **is applicable to** the laminated glass used in buildings. Other occasions can also use this Standard as reference. This Standard **is not applicable to** the laminated glass used in automobiles and other road vehicles.

2 Normative references

The provisions in the following standards become the provisions of this Standard through reference in this Standard. At time of publication, the editions indicated were valid. All standards are subject to revision, and parties who reach an agreement based on this Standard are encouraged to investigate the possibility of applying the latest editions of the standards indicated below.

GB/T 308-1989 *Rolling bearings - Steel balls (neq ISO 3290:1975)*

GB/T 531-1992 *Rubber, vulcanized - Determination of shore A hardness (neq ISO 7619:1986)*

GB/T 1216-1985 *External micrometer (neq ISO 3611:1978)*

GB/T 5137.2-1996 *Road vehicles - Safety glasses - Test methods for optical properties (eqv ISO/DIS 3538:1992)*

GB/T 5137.3-1996 *Road vehicles - Safety glazing materials - Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering (eqv ISO 3917:1992)*

GB/T 9963-1998 *Tempered glass (eqv JIS R 3206:1989)*

GB 11614-1999 *Float glass*

GB 17841-1999 *Tempered and heat-strengthened glass used in curtain walls (neq JIS R 3222:1996)*

JC 433-1991(1996) *Wired glass*

JC/T 511-1993 *Patterned glass*

JC/T 512-1993 *Packaging of automobile safety glass*

JC 536-1994 *Heat absorbing glass*

JC/T 677-1997 *Test method to model wind pressure for architectural glass under the uniform static loads*

3 Definitions

This Standard uses the following definitions.

3.1 Laminated glass

It refers to the glass products produced by putting the interlayer in between one layer of glass and one or more layers of glass or plastic materials.

3.2 Interlayer

It refers to the materials playing the roles of bonding and isolation between glass or between glass and plastic materials, so as to ensure that the laminated glass has resistance to impact, solar control and sound insulation.

3.3 Laminated glass of category I

It refers to the laminated glass making no requirements for the grape-shot bag impact test.

3.4 Laminated glass of category II-1

It refers to the laminated glass with the grape-shot bag impact height of 1,200mm and conforming to the provisions of Section 5.11.

3.5 Laminated glass of category II-2

It refers to the laminated glass with the grape-shot bag impact height of 750mm and conforming to the provisions of Section 5.11.

3.6 Laminated glass of category III

It refers to the laminated glass with the total thickness of not greater than 16mm and conforming to the provisions of Section 5.11.

4 Classification

4.1 CLASSIFY in accordance with shapes.

For the multilayer products, the products with the total raw glass thicknesses of greater than 24mm, and the products using tempered glass as raw glass, the thickness tolerances shall be agreed by the supply and requisitioning parties.

5.3.3.1 Thickness deviation of dry laminated glass

The thickness deviation of dry laminated glass cannot exceed the sum OF the tolerances of the raw glass sheets constituting laminated glass AND the interlayer tolerances. When the total interlayer thickness is less than 2mm, the tolerances shall not be taken into consideration. When the total interlayer thickness is greater than 2mm, the tolerances shall be ± 0.2mm.

5.3.3.2 Thickness deviation of wet laminated glass

The thickness deviation of wet laminated glass cannot exceed the sum OF the tolerances of the raw glass sheets constituting laminated glass AND the interlayer tolerances.

For the interlayer tolerances, SEE Table 5.

Table 5 Wet Laminated Glass - Interlayer Tolerances

mm

Interlayer thickness *d*	Tolerance *δ*
$d<1$	±0.4
$1\leqslant d<2$	±0.5
$2\leqslant d<3$	±0.6
$d\geqslant 3$	±0.7

5.3.4 Diagonal deviation

For the products made of rectangular laminated glass, when the side length is less than 2,400mm, the diagonal deviation shall not be greater than 4mm; when the side length is greater than 2,400mm, the diagonal deviation shall be agreed by the supply and requisitioning parties.

5.4 Flexibility

The flexibility of flat laminated glass shall not be greater than 0.3%. The flexibility of the laminated glass made of wired glass or tempered glass shall be agreed by the supply and requisitioning parties.

5.5 Visible light transmittance

The visible light transmittance shall be agreed by the supply and requisitioning parties. TAKE three test samples for testing. The three test samples are considered to be qualified when all of them conform to the requirements.

5.6 Visible light reflectance

The visible light reflectance shall be agreed by the supply and requisitioning parties. TAKE three test samples for testing. The three test samples are considered to be qualified when all of them conform to the requirements.

5.7 Heat resistance

The test samples are allowed to have cracks after the test. However, no bubbles or other defects can generate in the sections that are 13mm beyond the edges or cracks.

TAKE three test samples for testing. The three test samples are considered to be qualified when all of them conform to the requirements. When one of them fails to conform to the requirements, the three test samples are considered to be unqualified. When the second test sample conforms to the requirements, CONDUCT additional test to three new test samples. The three test samples are considered to be qualified when all of them conform to the requirements.

5.8 Moisture resistance

After the test, no bubbles or other defects can generate in the sections that are 15mm beyond the original edges, 25mm beyond the new trimming, and 10mm beyond the cracks.

TAKE three test samples for testing. The three test samples are considered to be qualified when all of them conform to the requirements. When one of them fails to conform to the requirements, the three test samples are considered to be unqualified. When the second test sample conforms to the requirements, CONDUCT additional test to three new test samples. The three test samples are considered to be qualified when all of them conform to the requirements.

5.9 Radiation resistance

After the test, no significant discoloration, bubbles and turbidity can generate in the test samples according to the requirements.

The relative reduction rate of visible light transmittance ΔT shall not be greater than 10%:

$$\Delta T = \frac{T_1 - T_2}{T_1} \times 100$$

Where:

ΔT - Relative reduction rate of visible light transmittance, %;

T_1 - Visible light transmittance before UV irradiation;

T_2 - Visible light transmittance after UV irradiation.

The laminated glass using patterned glass as raw glass makes no requirements for visible light transmittance.

TAKE three test samples for testing. The three test samples are considered to be qualified when all of them conform to the requirements. When one of them fails to conform to the requirements, the three test samples are considered to be unqualified. When the second test sample conforms to the requirements, CONDUCT additional test to three new test samples. The three test samples are considered to be qualified when all of them conform to the requirements.

5.10 Falling ball impact stripping performance

After the test, the interlayer cannot fracture, or cannot expose due to the peeled-off debris.

The tempered laminated glass, curved laminated glass, laminated glass with the total thickness of greater than 16mm, and laminated glass with three or more raw glass sheets shall be agreed by the supply and requisitioning parties.

TAKE six test samples for testing. The test samples are considered to be qualified when five of them or above conform to the requirements. The test samples are considered to be unqualified when three of them or below conform to the requirements. When four test samples conform to the requirements, CONDUCT additional test to six new test samples. The six test samples are considered to be qualified when all of them conform to the requirements.

5.11 Grape-shot bag impact performance

TAKE four test samples for testing. All of them shall conform to the provisions in Table 6.

This item is not applicable to assessing the products whose dimensions or areas are much bigger than those of the test samples.

Table 6 Grape-shot Bag Impact Performance

Category	Impact height, mm	Result determination
Category II-1	1,200	The test samples are not damaged; if the test samples are damaged, the damaged part shall not have cracks or holes that the ball with the diameter of 75mm can freely pass through.
Category II-2	750	
Category III	300 → 450 → 600 → 750 → 900 → 1,200	It is necessary to meet the requirements below at the same time:

thickness in the center of the four sides of glass plate. TAKE mean value. The value shall be rounded off to one decimal place.

6.4 Flexibility determination

USE the products made of flat laminated glass as test samples. PLACE the test samples in a vertical direction. FLATTEN the steel ruler or wire against the test samples. USE a feeler gauge or measuring tool with equivalent precision to determine the clearance between glass and steel ruler.

During segment of a circle, USE the percentage of the ratio OF arc height TO chord length to represent the flexibility. During waveform, USE the percentage of the ratio OF the height of trough to crest TO the distance between crests (or between troughs) to represent the flexibility.

6.5 Test of visible light transmittance

CONDUCT the test according to the Section 3.1 of GB/T 5137.2-1996.

6.6 Test of visible light reflectance

CONDUCT the test according to the Section 3.6 of GB/T 5137.2-1996.

6.7 Heat resistance test

6.7.1 Test samples

PRODUCE 300mm × 300mm test pieces under the same technological conditions by using the same materials with the products. Or directly CUT 300mm × 300mm test pieces from the products.

6.7.2 Test procedures

CONDUCT the test according to the Section 6.2 of GB/T 5137.3-1996. Before the test, vertically PLACE the test samples in the warm water at 65°C ± 3°C for 3min, so as to prevent thermal cracking caused by excessive thermal stress.

6.8 Moisture resistance test

6.8.1 Test samples

PRODUCE 300mm × 300mm test pieces under the same technological conditions by using the same materials with the products. Or directly CUT 300mm × 300mm test pieces from the products.

6.8.2 Test procedures

CONDUCT the test according to the Section 7.2 of GB/T 5137.3-1996.

the curved surfaces for supporting. The impact surfaces of curved laminated glass shall be determined according to the usage. However, the impact surfaces of patterned laminated glass and wired laminated glass are non-patterned surfaces in principle.

PLACE a steel ball with the mass of 1,040g at the height of 1,200mm away from the surface of the test sample. After free falling, the impact point shall be located in the circle using geometric center of the test sample as circle center along with the radius of 25mm. OBSERVE the status when one piece of constituted glass or above is damaged.

If the glass is not damaged, INCREASE the falling height for impact successively in the following order: 1,200mm, 1,500mm, 1,900mm, 2,400mm, 3,000mm, 3,800mm and 4,800mm. OBSERVE the status during each glass damage.

If the glass is still not damaged, USE a steel ball with the mass of 2,260g to impact according to the same procedures. OBSERVE the status during each glass damage.

If the glass is still not damaged, SELECT the steel balls with appropriate increasing masses according to the provisions of GB/T 308. IMPACT according to the same procedures. OBSERVE the status during glass damage.

6.11 Grape-shot bag impact test

6.11.1 Test samples

PRODUCE 1,930mm × 864mm test pieces under the same technological conditions by using the same materials with the products. Or directly CUT 1,930mm × 864mm test pieces from the products.

6.11.2 Test devices

For the provisions on sample devices, SEE Appendix B (normative).

6.11.3 Test procedures

Before the test, the test samples shall be kept under the conditions specified in the Section 6.1 for at least 4h. Immediately CONDUCT the test afterwards. PLACE the test samples on the test frame. FACE the thinner surface towards the impact body. However, the impact surfaces of patterned laminated glass and wired laminated glass are non-patterned surfaces in principle.

a) For the laminated glass of categories II-1 and II-2, respectively REMAIN the center of the impact body's maximum diameter at the heights of

1,200mm and 750mm. CONDUCT pendulum free falling. IMPACT near the center of the test sample once.

b) For the laminated glass of category III, REMAIN the center of the impact body's maximum diameter at the height of 300mm. CONDUCT pendulum free falling. When both inner and outer layers of glass constituting laminated glass are damaged, INSPECT according to the Section 5.11.

If the test sample is not damaged due to the above-mentioned impact. MODIFY the impact height according to the order in Table 8. CONTINUE to use the above-mentioned methods for impact. When two pieces of glass constituting laminated glass are damaged, INSPECT according to the Section 5.11.

In the process of the last two impacts, when one piece of glass constituting laminated glass is damaged, IMPACT again at the same height. If this piece of glass is still not damaged, INCREASE the impact height according to the following order: 300mm, 450mm, 600mm, 750mm, 900mm and 1,300mm, until this piece of glass is damaged. USE the above-mentioned methods for impact. INSPECT according to the Section 5.11.

RECORD and REPORT the maximum impact height and impact process of this product sample.

6.12 Wind pressure resistance test

CONDUCT the test according to JC/T 677.

7 Inspection rules

7.1 Inspection classification

The inspections are classified as exit-factory inspection and type inspection.

7.1.1 Exit-factory inspection: The inspection items are dimensional deviation, appearance quality and flexibility. If adding other inspection items according to the requirements, it shall be agreed by the supply and requisitioning parties.

7.1.2 Type inspection: The inspection items refer to all the technical requirements for this kind of products specified in this Standard.

CONDUCT the type inspection under one of the following circumstances:

a) During the trial production and pattern evaluation for the production after plant transfer of new or old products;

Other properties shall conform to the provisions of corresponding clauses in Chapter 5. Otherwise, they will be considered to be unqualified.

In the above-mentioned items, if one of them is unqualified, this batch of products will be considered as nonconforming products.

8 Packaging, symbols, transportation and storage

8.1 Packaging

The products shall be packed with containers or wooden cases. Each piece of glass shall be packed with plastic bags or paper. USE light soft materials that are not easy to cause appearance defects, such as glass scratches, etc., to fill the clearance between glass and packing container. The specific requirements shall conform to the provisions of JC/T 512.

8.2 Symbols

The symbols shall conform to the relevant provisions of JC/T 512. The words “This Side Up”, “Handle with Care”, etc. and glass thickness, categories, plant name or trademark shall be indicated on the outside of each packing container.

8.3 Transportation

Various kinds of vehicles used for product transportation, transporting rules and conditions shall conform to the relevant provisions of JC/T 512.

During transportation, do NOT tilt or lie the glass flat. The length direction shall be the same with the vehicle’s transportation direction. The vehicles shall be equipped with rainproof facilities.

8.4 Storage

The products shall be stored vertically in a dry room.

Appendix B

(Normative)

Grape-shot bag impact test devices

As shown in Figure B1, the main body of the test frame uses the channel steel with the height of greater than 100mm. USE bolts to fix it on the ground. ADD support rod on the back, so as to prevent displacement or incline during impacts. The wooden fixed frame is used for fixing the test samples. The contact positions around the fixed frame and the test samples use the rubber gaskets with shore A50 hardness conforming to the provisions of GB/T 531. After installing the test samples, the compression thickness of the rubber strip is 10% to 15% of the original thickness. Furthermore, the inner dimension of the wooden frame is about 19mm smaller than the dimension of the test sample.

As shown in Figure B2, the impact body refers to the leather bag with metal rod. INSERT a screw whose length is within the range of 330mm ± 13mm in the center of the leather bag. FILL with lead grapeshot. USE nuts to tighten the upper and lower ends of the bag afterwards. USE the glass fiber reinforced polyester nylon belt with the width of 12mm and the thickness of 0.15mm to wrap the surface of the leather bag crosswise and slantwise. COVER the entire surface until it becomes bag-shaped. The mass of the impact body is within the range of 45kg ± 0.1kg.

Note:

1 - USE the artificial belt with the thickness of 0.15mm to stitch two A sheets and four B sheets together [SEE b) in Figure B2]. The seam (dotted portion) is 0.5cm or so.

2 - USE lead ore with the nominal dimension of Φ2.5mm for filling.

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