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Vacuum Insulating Glass

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Vacuum Insulating Glass

1 Scope

This Standard stipulates the requirements, test methods, inspection rules, packaging, marking, transportation and storage of vacuum insulating glass.

This Standard is applicable to vacuum insulating glass for construction and home appliances. Vacuum insulating glass for other purposes may take this as a reference.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 1216 *External Micrometer*

GB/T 8170 *Rules of Rounding-off for Numerical Values & Expression and Judgement of Limiting Values*

GB/T 8484 *Graduation and Test Method for Thermal Insulating Properties of Doors and Windows*

GB/T 10295 *Thermal Insulation - Determination of Steady-state Thermal Resistance and Related Properties - Heat Flow Meter Apparatus*

GB/T 19889.3 *Acoustics - Measurement of Sound Insulation in Buildings and of Building Elements - Part 3: Laboratory Measurements of Airborne Sound Insulation of Building Elements*

GB/T 22476 *Calculation and Determination of Steady-state U Values (thermal transmittance) of Multiple Glazing*

GB/T 22523 *Feeler Gauge*

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Vacuum Insulating Glass

Vacuum insulating glass refers to a glass product, in which, two or more pieces of glass

5.4.1 Thermal Transmittance (*U* value) -- heat flow meter method

The sample is flat vacuum insulating glass manufactured with the same materials, the same structure and the same process conditions as the product. Sample size shall be not less than 300 mm × 300 mm.

In accordance with the method in Appendix B, measure thermal transmittance.

5.4.2 Thermal Transmittance (*K* value) -- calibration hot-box method

Take the product as a sample; measure in accordance with GB/T 8484.

5.5 Sound Insulation Properties

The sample is the product, or, 1,000 mm × 1,000 mm flat vacuum insulating glass manufactured with the same materials, the same thickness and the same process conditions as the product.

In accordance with GB/T 19889.3, measure the sound insulation properties of the sample.

5.6 Durability Test

5.6.1 Sample

The sample is flat vacuum insulating glass manufactured with the same materials, the same structure and the same process conditions as the product. Sample size shall be not less than 300 mm × 300 mm.

5.6.2 Test equipment

Test chambers of the following three test stages shall be provided. The test chambers shall satisfy the following conditions:

Stage 1: UV resistance test. The light source is ultraviolet lamp, with a power of 300 W and an irradiation intensity of ≥ 40 W/m^2 within the wavelength range of 315 nm ~ 380 nm. The temperature in the test chamber is controlled at 50 °C ± 3 °C. When the irradiation intensity cannot be reached, the ultraviolet lamp shall be replaced.

Stage 2: high and low temperature cycle test. Controllable temperature range: (-18 °C ± 2 °C) ~ (53 °C ± 1 °C); controllable temperature rising and falling rate: 14 °C/h ± 2 °C/h.

Stage 3: constant temperature and humidity test. Controllable temperature: 58 °C ± 1 °C; relative humidity: > 95%.

The temperature curve is shown in Figure 4.

conditions that the temperature is 58 °C ± 1 °C and the relative humidity is more than 95%, maintain for 7 weeks. When different test chambers are used, the maximum time interval of transferring the samples from Stage 2 test chamber to Stage 3 test chamber is 4 h.

5.6.3.5 Move the samples out of the constant temperature and humidity test chamber. In accordance with 5.4.1, measure the thermal transmittance of the vacuum insulating samples.

5.6.3.6 Respectively calculate the thermal transmittance variation (rate) of each sample; calculate the average value.

6 Inspection Rules

6.1 Inspection Classification

Inspection is classified into exit-factory inspection and type inspection.

6.2 Inspection Items

Exit-factory inspection items are: dimensional deviations, appearance quality and bow curvature.

Type inspection items are all the inspection items stipulated in Chapter 4.

6.3 Exit-factory Inspection

6.3.1 Group batch

Take 500 pieces of vacuum insulating glass continuously manufactured with the same materials and under the same process conditions as one batch. When the quantity is less than 500 pieces, they shall still be counted as one batch.

6.3.2 Sampling

The dimensional deviations, appearance quality and bow curvature shall be inspected through random sampling from the delivery batch in accordance with Table 7.

f) When quality supervision department proposes a request for type inspection.

6.4.2 Group batch

Take 500 pieces of vacuum insulating glass continuously manufactured with the same materials and under the same process conditions as one batch. When the quantity is less than 500 pieces, they shall still be counted as one batch.

6.4.3 Sampling

When the dimensional deviations, appearance quality and bow curvature are inspected, the sampling size is shown in Table 7.

6.4.4 Determination rules

6.4.4.1 When dimensional deviations, appearance quality and bow curvature are inspected, if the number of disqualified is less than, or, equals to the Number of Conformity Determination in Table 7, then, this batch shall be determined as qualified in this item. If the number of disqualified is more than, or, equals to the Number of Nonconformity Determination in Table 7, then, this batch of products shall be determined as disqualified in this item.

6.4.4.2 When the thermal insulation properties are inspected, take 1 piece of sample for the inspection. When the U value or K value satisfies Level-II or Level-I requirements in Table 5, then, it shall be determined as qualified in this item.

6.4.4.3 When the sound insulation properties are inspection, take 1 piece of sample for the inspection. When it satisfies the requirements, it shall be determined as qualified in this item.

6.4.4.4 When the durability test is conducted, take 3 samples for the inspection. When all the samples satisfy the requirements, they shall be determined as qualified in this item, otherwise, disqualified.

6.4.4.5 Among all the inspection items, if one inspection item is disqualified, then, this batch of products shall be determined as disqualified.

7 Packaging, Marking, Transportation and Storage

7.1 Packaging

Products shall be packed in containers or wooden boxes. Spacing materials that would not easily scratch the glass shall be used among the glasses, and between the glass and the packaging box for separation.

7.2 Marking

1---hemming;

2---glass;

3---exhaust vent;

4---Low-E coating surface;

5---pillar.

Figure A.1 -- Sketch Map of Structure of Typical Vacuum Insulating Glass

There is very little gas in the vacuum chamber of vacuum insulating glass. The convective heat transfer of the gas is very small in the vacuum chamber. Hence, the thermal transmittance is relatively low. In order to further enhance the thermal insulation properties of vacuum insulating glass, at least one piece of low-E coated glass may be used in the substrate of vacuum insulating glass. This may reduce the radiative heat transfer of vacuum insulating glass, which will further reduce the thermal transmittance of vacuum insulating glass.

Due to the existence of vacuum chamber, vacuum insulating glass effectively blocks the transmission of sound, and the sound insulation effect is quite satisfying. Meanwhile, vacuum insulating glass also has the characteristics of good anti-condensation effect, thermal transmittance free of the influence of the placement angle, and long service life, etc.

A.2 Vacuum Insulating Glass Prepared with Tempered Glass as the Substrate

Since the strength of tempered glass is higher than ordinary glass, vacuum insulating glass made with tempered glass as the substrate can, to a certain extent, enhance vacuum insulating glass's resistance to the external atmospheric pressure. In comparison with vacuum insulating glass made with ordinary glass, the mechanical properties (wind pressure resistance, temperature difference resistance and impact resistance) can also be improved. Meanwhile, for vacuum insulating glass made of tempered glass, the spacing of pillar may be properly expanded, which may further decrease the thermal transmittance of vacuum insulating glass, enhance the thermal insulation properties, and simultaneously, make the glass more nice-looking.

Due to the particularity of the structure and the processing of vacuum insulating glass, based on the current technical level, some mechanical properties (for example, impact resistance) of vacuum insulating glass made of tempered glass as the substrate are lower than individual pieces of tempered glass before lamination.

NOTE: tempered glass refers to physical tempered glass.

A.3 Vacuum Insulating Glass Composite Products

Vacuum insulating glass may be produced into various composite products, such as: vacuum composite laminated glass, vacuum composite hollow glass, vacuum, and

Appendix B

(normative)

U Value Measurement by Heat Meter Flow Method

B.1 Principle

In accordance with GB/T 10295, measure the thermal resistance of vacuum insulating glass; obtain U value through calculation.

B.2 Inspection Devices

B.2.1 Heat meter flow

Heat meter flow shall comply with the stipulations of GB/T 10295. The size of the central measurement area of the heat meter flow shall be not less than 100 mm × 100 mm.

B.2.2 Uniform temperature plate

Uniform temperature plate shall satisfy the following conditions:

a) The texture and thickness of uniform temperature plate shall be uniform and consistent, so as to ensure contact with the entire sample surface.

b) For sample with an exhaust vent, the thickness of uniform temperature plate shall be more than the height of the protective cap of the exhaust vent; remove the part where the uniform temperature plate contacts the protective cap, so as to ensure that the uniform temperature plate is in contact with the entire sample surface.

c) The size of uniform temperature plate shall be not less than the size of the sample.

d) The thickness of uniform temperature plate shall not be changed by the experimental pressure. The thermal conductivity of the texture of the uniform temperature plate shall be free of the influence of moisture absorption.

e) The thermal resistance of each piece of uniform temperature plate shall be between 0.03 $m^2 \bullet K/W$ and 0.1 $m^2 \bullet K/W$.

B.3 Sample

The distance from the edge of the sample to the measurement area shall be at least 90 mm, as it is shown in Figure B.1.

R---thermal resistance of sample, expressed in (m^2 • K/W);

R_1---total thermal resistance of two uniform temperature plates and sample, expressed in (m^2 • K/W);

R_0---thermal resistance of two uniform temperature plates, expressed in (m^2 • K/W).

R, R_1 and R_0 shall retain three decimals.

NOTE: generally speaking, the thermal resistance of one uniform temperature plate is $R_0/2$.

In accordance with Formula (B.2), calculate the U value of vacuum insulating glass; retain 2 significant figures. The heat transfer coefficient of the interior surface and the exterior surface of vacuum insulating glass is shown in GB/T 22476.

$$\frac{1}{U}=R+\frac{1}{h_e}+\frac{1}{h_i} \qquad \text{(B.2)}$$

Where,

R---thermal resistance of vacuum insulating glass sample, expressed in (m^2 • K/W);

h_e---heat transfer coefficient of exterior surface, expressed in [W / (m^2 • K)];

h_i---heat transfer coefficient of interior surface, expressed in [W / (m^2 • K)].

For a group of samples of the same specification, the first piece of sample shall be tested twice; the percentage difference between the two obtained results shall be not more than 3.0%, as it is shown in Figure (B.3).

$$\frac{|U_{1,1}-U_{1,2}|}{(U_{1,1}+U_{1,2})/2}\times 100\% \leqslant 3.0\% \qquad \text{(B.3)}$$

Where,

$U_{1,1}$---test result of the first U value of the first piece of sample, expressed in [W / (m^2 • K)];

$U_{1,2}$---test result of the second U value of the first piece of sample, expressed in [W / (m^2 • K)].

If the percentage difference of the two U values of the first piece of sample is more than 3.0%, the test method and the environment shall be adjusted, then, measure again.

The U value of the first piece of sample shall be the average value of the two results $U_{1,1}$ and $U_{1,2}$, as it is shown in Figure (B.4):

------ The End ------