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Smart Glazing Used on Road Vehicles - Part 2: Polymer Dispersed Liquid Crystal Glazing

汽车用智能变色玻璃 第 2 部分：聚合物分散液晶调光玻璃

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Smart Glazing Used on Road Vehicles - Part 2: Polymer Dispersed Liquid Crystal Glazing

1 Scope

This document specifies the requirements, test methods, inspection rules, packaging, transportation and storage of polymer dispersed liquid crystal glazing.

This document applies to the design, production and delivery of smart glazing products used on road vehicles that use polymer dispersed liquid crystal as the dimming medium.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. 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 2410 Determination of Light Transmittance and Haze of Transparent Plastics

GB/T 5137.2-2020 Test Methods of Safety Glazing Materials Used on Road Vehicles - Part 2: Optical Properties Tests

GB/T 5137.4 Test Methods of Safety Glazing Materials Used on Road Vehicles - Part 4: Determination of Solar Characteristic

GB/T 11942 Test Method of Chroma for Color Building Materials

GB/T 30142 Measuring Methods for Shielding Effectiveness of Planar Electromagnetic Shielding Materials

GB/T 35847 Switchable Glazing Filmed by Polymer Dispersed Liquid Crystal

GB/T 42788 Terms of Smart Glass

JC/T 2631-2021 Electrochromic Glass

JJF 1615 Calibration Specification for Solar Simulators

3 Terms and Definitions

The terms and definitions defined in GB/T 42788, JC/T 2631-2021 and GB/T 35847, and the following are applicable to this document.

3.1 smart glazing used on road vehicles

A glazing product used on road vehicles that, under the influence or excitation of an external energy field, can alter its optical properties, such as transmission, reflection or absorption in specific wavelength bands.

3.2 polymer dispersed liquid crystal glazing

A glazing product that combines a dimming film consisting of two flexible transparent conductive films and a layer of polymer dispersed liquid crystal material through interlayer or film bonding processes and can rapidly switch between regular transmission and diffuse transmission under the control of an external electric field.

[source: GB/T 42788-2023, 3.4.2, modified]

3.3 transparent state

Under given control conditions, the state of polymer dispersed liquid crystal glazing (3.2) with the lowest haze.

3.4 haze state

Under given control conditions, the state of polymer dispersed liquid crystal glazing (3.2) with the highest haze.

3.5 forward polymer dispersed liquid crystal glazing

A polymer dispersed liquid crystal glazing (3.2) that exhibits diffuse transmission when power is off and transitions to regular transmission when power is on.

3.6 reverse polymer dispersed liquid crystal glazing

A polymer dispersed liquid crystal glazing (3.2) that exhibits regular transmission when power is off and transitions to diffuse transmission when power is on.

3.7 dyed polymer dispersed liquid crystal glazing

A polymer dispersed liquid crystal glazing (3.2) in which colorants are added to the polymer dispersed liquid crystal layer to achieve color intensity variations.

3.8 regular luminous transmittance

Within the visible light spectrum (380 nm ~ 780 nm), the ratio of the regular luminous flux passing through the specimen to the incident luminous flux.

[source: GB/T 35847-2018, 3.4, modified]

3.9 contrast ratio

Under given control conditions, the ratio of the visible light transmittance of the dyed polymer dispersed liquid crystal glazing (3.7) in its transparent state (3.3) to that in the haze state (3.4).

3.10 puncture

The phenomenon of localized burning of the polymer dispersed liquid crystal layer caused by discharge between electrodes under the influence of an electric field.

[source: GB/T 35847-2018, 3.2, modified]

4 Classification

In accordance with power-on/off state, it is classified into forward polymer dispersed liquid crystal glazing and reverse polymer dispersed liquid crystal glazing.

In accordance with whether dyes are added to the liquid crystal layer, it is classified into non-dyed polymer dispersed liquid crystal glazing and dyed polymer dispersed liquid crystal glazing.

In accordance with the production process, it is classified into interlayer polymer dispersed liquid crystal glazing and film bonding polymer dispersed liquid crystal glazing.

5 Requirements

5.1 Appearance Quality of Dimming Area

The appearance quality of the dimming area of the polymer dispersed liquid crystal glazing in both haze and transparent states shall meet the requirements of Table 1. The corresponding state or appearance characteristics required for different locations after assembly shall be agreed upon by the supply-side and the demand-side.

5.13 Overpressure Performance

After the test, the specimen shall have no punctures.

6 Test Methods

6.1 General Rules

6.1.1 Requirements for test pieces

If the inspection item does not affect the performance of the specimen, then the specimen can be used to continue testing for other items. When using specially made test pieces, the test pieces shall be of the same structure, material, and manufactured under the same process conditions as the product.

The requirements for the size of the dimming area for test pieces of different dimensions are shown in Table 3.

6.1.2 Adjustment and control requirements for dimming area

The dimming control system and its control program shall be provided by the manufacturer and consistent with the actual operating conditions of the product, enabling the specimen to transition to the desired state and remain stable. The adjustment and control requirements for the dimming area and the test results shall be simultaneously recorded.

6.1.3 Test conditions

Unless otherwise specified, the test shall be conducted under the following environmental conditions:

a) Temperature: (20 ± 5) °C;

b) Relative humidity: 40% ~ 80%.

6.2 Appearance Quality of Dimming Area

6.2.1 Specimen

Use the product as the specimen.

6.2.2 Test procedures

Connect the specimen to the dimming control system. In accordance with its control program, after adjusting it to the haze or transparent state and maintaining stability, under an illumination of (1,000 ± 200) lx or in good natural or diffused light background conditions, vertically place the specimen, and at a distance of 600 mm from the specimen, visually observe it, and record any visible appearance defects. The size of point-like defects and the width of line defects are measured using a reading microscope with a division value of 0.01 mm. The length of line defects and the distance between point-like defects are measured using a steel ruler with a division value of 1 mm or a measuring instrument of equivalent accuracy.

6.3 Haze of Dimming Area

6.3.1 Specimen

Use a flat product or test pieces as the specimens. The size of the test pieces shall be at least 100 mm × 100 mm, and 3 pieces shall be used.

6.3.2 Test device

A haze meter or spectrophotometer that conforms to the requirements of GB/T 2410.

6.3.3 Test procedures

Place the specimen under the environmental conditions specified in 6.1.3 for at least 2 hours. Connect the specimen to the dimming control system, and in accordance with its control program, adjust it to the haze or transparent state and maintain stability. In accordance with the haze meter method or spectrophotometer method specified in GB/T 2410, use light source A to respectively test the haze of the dimming area in both the haze and transparent states. Measure one point for each specimen, and round the result to 0.01%.

6.4 Regular Luminous Transmittance and its Deviation of Dimming Area

6.4.1 Specimen

Use a flat product or test piece as the specimen. The size of the test piece shall be at least 100 mm × 100 mm.

6.4.2 Test device

Conform to the provisions of 5.3 in GB/T 5137.2-2020.

6.4.3 Test procedures

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