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Automotive solar control window films

汽车车窗玻璃遮阳膜

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Automotive solar control window films

1 Scope

This Standard specifies the technical requirements, test methods, inspection rules and application requirements for automotive solar control window films.

This Standard is applicable to the production and inspection of automotive solar control window films. It is also applicable to the inspection of motor vehicle safety technology.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 2680-1994, *Determination of light transmittance, solar direct transmittance, total solar energy transmittance and ultraviolet transmittance for glass in building and related glazing factors*

GB/T 5137.1, *Test methods of safety glazing materials used on road vehicles - Part 1: Mechanical properties tests*

GB/T 5137.2, *Test methods of safety glazing materials used on road vehicles - Part 2: Optical properties tests*

GB 5768.2, *Road traffic signs and markings - Part 2: Road traffic signs*

GB/T 8417, *Colors of light signals*

GB 9656, *Safety technical specification for glazing materials used in power-driven vehicles*

GB 11614, *Flat glass*

GB 14887, *Road traffic signal lamps*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 5137.1, GB 9656 as well as the followings apply.

3.1 automotive solar control window film

The film that pasted on the front, side and rear windshield safety glass of the car, can block the heat of solar radiation, but does not affect the safe driving of driver himself and others.

3.2 visible light transmittance

The ratio of the transmitted visible light flux to the incident visible light flux.

3.3 UV ray transmittance

The ratio of the transmitted UV spectral radiant flux to the incident UV spectral radiant flux.

3.4 solar transmittance

The ratio of the transmitted solar spectral radiant flux to the incident solar spectral radiant flux.

3.5 visible light reflectance

The ratio of reflected visible light flux to incident visible light flux.

3.6 specular reflection

A reflective phenomenon that when the parallel rays are incident on the surface of the object, the reflected rays are still parallel, and the angle of incidence is equal to the angle of reflection.

4 Technical requirements

4.1 Classification

4.1.1 Classified by visible light transmittance

According to the different transmittance of visible light, the automotive solar control window film (hereinafter referred to as solar control film) is divided into Class I, Class II and Class III.

4.1.2 Classified by solar transmittance

According to the different sunlight transmittance, the solar control film can be divided into grade A, grade B and grade C.

4.2 General requirements

4.2.1 Appearance

The solar control film shall be free from cracks, scratches, air bubbles and damages.

5 Test methods

5.1 Preparation before the test

5.1.1 Sample preparation

Requirements for specimen preparation:

- a) Randomly select a full roll of solar control film from the solar control film batch.
- b) Randomly intercept 2 m² solar control film.
- c) Paste the solar control film on the automotive-grade float glass (hereinafter referred to as float glass) of the specified size according to the manufacturer's instructions to make a specimen. Among them, the thickness of the float glass is 3 mm±0.2 mm, and the visible light transmittance is 90%±2%, which shall meet the requirements of GB 11614.
- d) If there are special instructions in the test method (such as mechanical performance test), prepare the specimen according to the requirements of the test.

5.1.2 Sample storage

Unless otherwise specified, the specimen shall be placed in an environment with a temperature of 23°C ± 5°C and a relative humidity not greater than 60% for at least 24 h before the test. Then perform various tests.

5.1.3 Test conditions

Unless otherwise specified, general tests shall be carried out in an environment with a temperature of 23°C±5°C and a relative humidity not greater than 60%.

5.2 Inspection of general requirements

In a daytime environment with illuminance greater than or equal to 150 lx, visually inspect the specimen.

5.3 Transmittance test

5.3.1 Test geometry

Use the geometry of vertical illumination and vertical detection. The angle between the optical axis of the illuminating beam and the normal of the sample surface does not exceed 10°. The angle between any light in the illumination beam and the optical axis does not exceed 5°.

5.3.2 Visible light transmittance test

Select a specimen with a size of 50 mm × 50 mm. In the spectral range of 380 nm ~ 780 nm, test the visible light spectral transmittance of float glass and float glass with solar control film respectively. The wavelength interval is 10 nm. Calculate the visible light transmittance T_1 of float glass and the visible light transmittance T_2 of float glass with solar control film according to formula (1) in GB/T 2680-1994. Calculate the visible light transmittance T of the solar control film according to the following formula:

$$T = T_2 / T_1 \times 100\%$$

5.3.3 UV ray transmittance test

Select a specimen with a size of 50 mm × 50 mm. In the 280 nm ~ 380 nm spectral range, test the ultraviolet spectral transmittance of the specimen. The wavelength interval is 5 nm. Calculate the UV ray transmittance of the specimen according to formula (31) in GB/T 2680-1994.

5.3.4 Solar transmittance test

Select a specimen with a size of 50 mm × 50 mm. In the spectral range of 350 nm ~ 2500 nm, test the solar light spectral transmittance of the specimen. The wavelength interval is 10 nm. Calculate the solar transmittance of the specimen according to formula (9) in GB/T 2680-1994.

5.4 Visible light reflectance test

5.4.1 Test geometry

Use the geometry with 5° illumination and 5° detection. The angle between the optical axis of the illuminating beam and the normal of the sample surface does not exceed 10°. The angle between any light in the illumination beam and the optical axis does not exceed 5°.

5.4.2 Test method

Select a specimen with a size of 50 mm × 50 mm. Within the spectral range of 380 nm ~ 780 nm, test the visible light spectral reflectance of the glass surface and the film surface of the specimen respectively. The wavelength interval is 10 nm. Calculate the visible light reflectance of the specimen according to formula (4) in GB/T 2680-1994.

5.5 Traffic signal recognition test

5.5.1 Recognition test of road traffic light color

Light up a group of road traffic lights that meet the requirements of GB 14887. Place a specimen with a size of 50 mm × 150 mm in front of the detector of the spectral analysis system. According to the method specified in GB/T 8417, test the chromaticity

5.10 Solvent resistance test

Submerge the 50 mm × 150 mm specimen in 93[#] gasoline, 0[#] diesel oil, and SAE40 lubricating oil for 30 min respectively. After the test, take out and wipe clean. Dry at 20°C±5°C. Examine the specimen with a four-fold magnifying glass.

5.11 Mechanical property test

5.11.1 Tensile strength and tensile elongation test

Prepare three 25 mm × 150 mm solar control films. Tear off the 100 mm release film in the middle. Put the part with the release film at both ends into the clamping device of the electronic tensile testing machine with an accuracy of 0.5. The load shall be evenly distributed across the width of the solar control film. Turn on the testing machine. Stretch at a speed of 300 mm/min. Record the tensile strength and tensile elongation of the solar control film when it breaks, respectively.

5.11.2 Adhesion strength test

Cut a 25 mm × 250 mm solar control film. Tear off the 150 mm release film. Paste it on automotive grade float glass to make a sample. Install the sample on an electronic tensile testing machine with an accuracy of 0.5. Make the solar control film with release film at 180° to the base plate. The load shall be evenly distributed across the width of the sample. Pull the solar control film at a speed of 300 mm/min. After peeling off about 25 mm, record the adhesion strength.

5.12 Radiation resistance test

Put the 50 mm × 50 mm specimen into the aging box. Irradiated by light with a spectral wavelength of 300 nm ~ 800 nm, its radiation intensity is 1000 W/m² ± 100 W/m². Within the entire specimen area, the deviation of the radiation intensity shall not be greater than ±10%. The temperature of the blackboard in the box is 63°C±3°C. Use continuous lighting. Test 600 h in total. After the test, retest the visible light transmittance, solar transmittance and UV ray transmittance of the specimen.

6 Inspection rules

6.1 Inspection classification

The inspection of the solar control film is divided into type inspection and exit-factory inspection.

6.2 Type inspection

6.2.1 Inspection conditions

The type inspection of the solar control film is carried out in the following situations:

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Contact: Wayne Zheng, Sales@ChineseStandard.net

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