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Natural Weathering Exposure Tests for Automotive Non-Metallic Materials and Parts

汽车非金属材料及部件

自然曝露试验方法

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Foreword

This Standard was drafted as per the rules specified in GB/T 1.1-2009.

This Standard was proposed by the Ministry of Industry and Information Technology.

This Standard shall be under the jurisdiction of National Technical Committee of Auto Standardization (SAC/TC 114).

Drafting organizations of this Standard: Hainan Tropical Automobile Test Co., Ltd., Technical Center of China FAW Group Corporation, National Automobile Quality Supervision and Test Center (Xiangyang), and FAW - Volkswagen Automotive Co., Ltd..

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Natural Weathering Exposure Tests for Automotive Non-Metallic Materials and Parts

1 Scope

This Standard specifies the principle, exposure site, equipment on exposure site, test sample, test duration, test procedure, and test report of the natural weathering exposure tests for automotive non-metallic materials and parts.

This Standard is applicable to the natural weathering exposure tests for automotive non-metallic materials and parts.

2 Normative References

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this standard.

GB/T 3511 Rubber Vulcanized or Thermoplastic - Resistance to Weathering

GB/T 3681 Plastics - Methods of Exposure to Direct Weathering, to Weathering Using Glass-Filtered Daylight, and to Intensified Weathering by Daylight Using Fresnel Mirrors

GB/T 6739 Paints and Varnishes - Determination of Film Hardness by Pencil Test

GB/T 8807 Test Method for Specular Gloss of Plastics

GB/T 9286 Paints and Varnishes-Cross Cut Test for Films

GB/T 9754 Paints and Varnishes - Determination of Specular Gloss of Non-Metallic Paint Films at 20° 60°and 85°

GB/T 11186 Methods for Measuring the Color of Paint Films (All Parts)

GB/T 15596 Plastics - Determination of Changes in Color and Variations in Properties after Exposure to Daylight under Glass, Natural Weathering or Laboratory Light Sources

The exposure direction of exposure frame shall face the equator, namely, from south to north. In the northern hemisphere, the front side of specimen shall face the due south direction; in the southern hemisphere, the front side of specimen shall face the due north direction. However, to adapt to the special test purpose, the specimen can be placed facing any direction. The tilted angle between specimen's exposure surface and the horizontal surface can be realized through adjusting the tilted position of the exposure frame. The typical exposure angle includes exposure site's geographic latitude angle, 90°, 45°, and 5°. If it is specially required, the exposure frame can adopt any one angle. Exposure with back plate and black box exposure generally adopt 5° angle. The exposure frames shall be set at the intervals that ensure sufficient space for placing the specimen, smooth natural ventilation, and without mutual sunlight shielding. Generally, the interval shall be no less than 1m. Automotive exterior materials and part exposure test equipment shall be arranged at the place where the specimen shall be avoided sunlight shielding by other objects. The lowest position of specimen on the frame or black box against the ground shall be 0.45m, so as to avoid touch the objects on the ground, and prevent the unexpected damage of the specimen during the exposure period.

6.2.2 Direct exposure device

6.2.2.1 Open exposure frame (general method)

Open exposure frame is applicable to the exposure test for exterior materials, and various shapes and dimensions of specimens. Generally, it is made of aluminum alloy. Aluminum alloy exposure frame is suitable for different climatic regions; iron and steel materials through proper painting treatment and wood materials without any treatment are suitable for desert region; copper-nickel alloy material is suitable for high corrosive regions. Exposure frame shall have sufficient length and width to install and fix the specimens, which are ensured not to influence each other. When installing the specimen, generally use porcelain insulation folder, plastic stopper pin, wooden frame, wire and lining plate through corrosion-resistant treatment, fastening screws and etc.

6.2.2.2 Exposure frame with backplane (coating system)

Backplane can be made of metal sheet and wooden plywood. When the fixed holder is made of plywood for directly installing the specimen, if the plywood occurs obvious layering or significant fiber releasing, then it shall be replaced timely. The plywood with medium and high density covering layer is more suitable than the plywood without covering layer to work as the backplane, so that reduce the replacing times of the backplane. In the dry climatic region, the thickness of applied plywood is generally no less than 13mm; while in the subtropical or tropical climatic regions, the thickness of applied plywood is generally no more than 19mm. Use good weather-resistance paint to seal the edges of plywood to prevent the delamination.

6.2.2.3 Exposure black box (only applicable to the coating system)

more solar radiation.

6.2.4 Other exposure device (such as shelter shed, immersion box, and etc.)

Shielding exposure test indicates place the specimen under the shield structure to avoid exposing under the direct exposure effect from sun, rain, snow. Shelter shed shall be made of corrosion-resistant and weather-resistant materials, such as aluminum alloy and others. Immersion exposure test indicates immerse part or entire specimen into the test solution to expose; the immersing device shall be made of corrosion-resistant and oil proof materials, or special product chamber. The structure and dimension of these special devices shall be confirmed as per the shape and dimension of the specimen, for the benefit of the installation and operation of the specimen, or as per the customer's requirements.

6.3 Measuring equipment

6.3.1 Equipment applicable to the direct exposure test include:

a) Air temperature (daily maximum or minimum value) measuring equipment;

b) Black panel temperature (daily maximum or minimum value) measuring equipment;

c) Relative humidity (daily maximum or minimum value) measuring equipment;

d) Wetting time measuring equipment;

e) Rainfall (mm) measuring equipment;

f) Measuring equipment of the total amount of solar radiation;

g) Measuring equipment of the amount of solar ultraviolet radiation (300nm ~385nm);

h) Other (such as wind direction, wind speed, and atmospheric pressure) measuring equipment.

6.3.2 Equipment applicable to the direct exposure test under the glass include:

a) Pyranometer. It shall be installed under the glass the same as the chamber body (the same exposure angle), the measured wavelength rang is within 295nm~2800nm, record and provide the hourly amount of radiation, and time domain above accumulated amount of radiation;

b) Ultraviolet radiation intensity meter. It shall be installed under the glass the same as the chamber body (the same exposure angle), the measured wavelength rang is within 295nm~385nm, record and provide the hourly amount of radiation, and time domain above accumulated amount of radiation;

c) Air temperature measuring equipment in the test chamber;

8 Test Period

8.1 Setting method of test period

8.1.1 In addition to specimen types, uses, and test objectives, the setting of test period shall also consider correctly mastering the aging process of the specimen.

8.1.2 Exposure period can be set as per time bucket (month, year), actually receiving solar radiation of the specimen surface (MJ/m^2) or aging degree of the specimen.

8.2 Expression of test period

8.2.1 Set the test period as per the time bucket, take day, month, and year as the base in principle.

8.2.2 Set test period as per the amount of solar radiation; accumulate when the specimen surface receives certain solar radiation (MJ/m^2), at this time clearly record the exposure commencement and completion dates.

8.2.3 Set test period (applicable to the indirect exposure) as per the solar radiation TNR value (MJ/m^2) corrected by the temperature. The limit selection can refer to Appendix B.

8.2.4 Set test period as per the change of specimen performance, namely, the test period shall be subject to certain performance reaches the change limit; at this time, in addition to clearly record the exposure commencement and completion dates, also record the specimen receiving total amount of solar radiation, and total energy of solar ultraviolet radiation.

8.3 Test commencement date

In principle, set the exposure commencement date to be from Spring ending to Summer Beginning. If the exposure period exceeds one year above, then generally, the exposure commencement date shall not be stipulated specially.

9 Test Procedures

9.1 Test preparation

9.1.1 Acceptance of test sample. Check the shipment damage, assembly defects and other surface defects, record them well; if necessary photograph them for record.

9.1.2 Determination of measuring position. The instrument needs or can be used to measure the color, gloss surface or part assembly; the measuring position shall select

provisions of GB/T 11186, by selecting standard illuminant D65 and in the filed of view with observer's sight angle 10°; while the DOI or PGD value measurement shall be conducted as per the use instructions of DOI Instrument; the plastic, rubber surface color measurement shall be conducted as per the relevant provisions of GB/T 15596 and GB/T 3511.

9.2.4 Coating pencil hardness test

If required, when the test begins and after it ends, according to the manual operation method stipulated in GB/T 6739, test the pencil hardness. Relevant hardness measuring instrument can also be selected to test.

9.2.5 Coating adhesion test

If required, when the test begins and after it ends, according to the coating adhesion cross cut test stipulated in GB/T 9286, test the coating adhesion.

9.3 Inspection cycle

Inspection shall, before test, be carried out as per the selected item requirements and the provisions in 9.2. During the entire test period, the inspection cycle for various performance changes includes: new products are required to inspect once every half a month within the primary three months; the products that have been manufactured for three months to one year shall be inspected once every month; while the products that have been manufactured over one year shall be inspected once every three months. If it is the mass-produced products' identification and acceptance test, the inspection intervals can be prolonged relatively, namely, the times of the inspection can be reduced. Specimen surface receiving certain amount of solar radiation can also be regarded as the inspection cycle.

9.4 Exposure test

In general, the automotive non-metallic materials and component specimens simulate their state in the vehicles to install and expose. The exposure mode of automotive non-metallic exterior materials and components shall be direct atmospheric exposure test. The automotive interior materials and components select light-heat-aging-resistant natural weather indirect exposure test. As for the installation of automotive interior materials and component specimens, it is required to place the specimen surface or components under 50mm~100mm test chamber glass paralleling the internal vehicle surface where the solar radiation is strongest. The specimen shall be ensured to keep away from the east or west end of test chamber about 150mm, while from the north and south sides of test chamber about 100mm. If there are high-temperature-resistant control requirements, set the temperature as per not only the Appendix B, but also the test requirements.

To simulate the specimen's use condition and accelerated aging speed on the vehicle,

Appendix B
(Normative)
Temperature Control and Temperature Corrected Radiation Energy

B.1 Definition of temperature corrected radiation energy

During the natural exposure test, if the specimen temperature is different, even the same amount of solar radiation may exert different influence on the specimen aging. Given the joint effects of solar radiation and temperature against the material aging, the temperature corrected solar radiation energy is comprehensively obtained. The calculation formula is as follows:

$$TNR = \sum_{\text{Beginning}}^{\text{Ending}} R \times e^{\{13.643-[5\,000/(T+273.15)]\}} \quad \cdots\cdots (B.1)$$

Where:

TNR – Temperature corrected solar radiation energy, take hour as the basis, expressed in MJ/m^2. Every 5min, calculate once the continuous temperature and radiation intensity, accumulate 12 times calculation values within 1h.

R – Under the glass, at the same angle, measure the hourly solar radiation intensity. Hourly radiation intensity is accumulatively calculated every 5min, it is calculated by the mean value every 5min.

T – Temperature of reference black panel in the chamber. Continuous temperature measurement every 5min shall take mean temperature at 5min intervals as the calculation value.

B.2 Control temperature and temperature corrected radiation energy

According to the position where the specimen is located in the vehicle, and the vehicle used glass (generally select the II), select the upper limit control temperature and solar radiation energy, see Table B.1.

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