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Road vehicles - Lighting and light-signalling devices - Environmental endurance

道路车辆 外部照明和光信号装置 环境耐久性

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Table of Contents

Road vehicles - Lighting and light-signalling devices - Environmental endurance

1 Scope

This document specifies the test requirements for environmental endurance tests of road vehicle exterior lighting and light signaling devices (except retro-reflective devices), thermal cycle tests, sealing tests, thermal shock tests, thermal deformation tests, salt spray tests, dust tests, accompanied vibration tests, impact vibration tests, waterproof tests, lubricating oil resistance, fuel resistance and cleaning fluid resistance tests, light source irradiation tests, fog tests, highly accelerated life tests, highly accelerated stress screening tests, focusing tests, etc.

This document is applicable to categories M, N, O, L road vehicle's exterior lighting and light signaling devices.

2 Normative references

The contents of the following documents constitute essential clauses of this document through normative references in the text. Among them, for dated references, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies to this document.

GB 4599 Road illumination devices and systems for motor vehicles

GB 4785 Prescription for installation of the external lighting and light-signalling devices for motor vehicles and their trailers

GB/T 6495.9 Photovoltaic devices - Part 9: Solar simulator performance requirements

GB/T 32466-2015 Accelerated stress testing procedures for electric and electronic products - Guidance for highly accelerated stress screen

3 Terms and definitions

The terms and definitions defined in GB 4785, as well as the following terms and definitions, apply to this document.

3.1

This test is used to evaluate the temperature and humidity resistance of external lighting and light signaling devices.

5.2.2 Number of samples

2 lighting devices or 2 light signaling devices.

5.2.3 Test conditions

The test shall be carried out in a temperature and humidity test chamber.

5.2.4 Test method

5.2.4.1 During the test, the sample is not lit.

5.2.4.2 According to 4.4 and Chapter 6, the sample is initially tested for changes in photometric values and sealing tests.

5.2.4.3 The sample is placed in the test chamber in a simulated normal installation position and tested according to the number of cycles required by 5.2.5.

5.2.4.4 Each test cycle is 720 minutes, including the following processes (see Figure 2).

- Heating process 1: The temperature rises from 23 °C to 80 °C; the relative humidity rises to 80% (for category L vehicle lamps, the temperature is allowed to rise from 23 °C to 60 °C, the relative humidity rises to 80%); the heating time is 60 minutes.

- Damp heat process: Maintain the temperature at 80 °C (for category L vehicle lamps, the temperature is allowed to be maintained at 60 °C), the relative humidity is 80% for a duration of 240 min.

- Cooling process: From 80 °C (for category L vehicle lamps, the temperature is allowed to be reduced from 60 °C and the relative humidity 80% to -40 °C); when the temperature drops to 20 °C, the relative humidity shall be 20% ~ 50%; when the temperature is below 10 °C, there is no requirement for humidity. The cooling time is 120 min.

- Maintain low temperature: -40 °C, for a duration of 240 min.

- Heating process 2: Heating to 23 °C; heating time is 60 min; when the temperature is greater than 10 °C, the relative humidity is controlled at 20% ~ 40%.

For devices with front lighting function, 8 cycles of test shall be carried out according to the requirements of Figure 2; devices with only optical signal function shall be carried out according to the requirements of Figure 2.

5.2.4.5 According to 4.4 and Chapter 6, retest the sample for photometric value change and sealing test.

except for the vents/ventilated membranes, etc., any vents/ventilated membranes, etc. can be retained; all other vents/ventilated membranes, etc. can be sealed. Apply 3 kPa air pressure through the retained ventilation structure, until the air pressure stabilizes; immerse the sample in water.

Immersion depth: The entire sample is immersed in the horizontal plane; the sample is rotated to place the bonding, welding or each connection 50 mm below the horizontal plane in turn.

Immersion time: 15 s (for each evaluation area).

6.4.2 If the sample is an open structure, that is, it is sealed with the vehicle body through a sealing gasket, it is necessary to use a special sealing test bracket simulating the vehicle body (the bracket needs to have a vent); seal the sample with the bracket; apply 3 kPa air pressure through the vent on the bracket; immerse the sample in water after the air pressure stabilizes.

Immersion depth: The entire sample is immersed in the horizontal plane; the sample is rotated to place the bonding, welding or each connection 50 mm below the horizontal plane in turn.

Immersion time: 15 s (for each evaluation area).

6.5 Result judgment

During the test, visually inspect the sample at the bonding, welding, each connection; no bubbles shall be generated.

7 Thermal shock test

7.1 Applicability

This test is applicable to lighting devices and light signaling devices installed below the lower edge of the door side window; it is used to evaluate their thermal shock resistance.

7.2 Number of samples

2 lighting devices or 2 light signaling devices.

7.3 Test conditions

The test shall be carried out at room temperature.

7.4 Test method

7.4.1 Perform the initial test of the sealing test on the sample in accordance with Chapter 6.

7.4.2 At room temperature, the sample is lit at the maximum power working state (as specified by the manufacturer) under the test voltage for 30 minutes. For multi-lamp units, all functions that can work simultaneously shall be lit.

7.4.3 After the function is continuously lit, immediately immerse the entire outer surface of the light distribution lens including the bonding part of the light distribution lens in the prepared 4 °C ± 2 °C water for 5 minutes. If necessary, the connectors, ventilation, ventilation parts that may be flooded can be temporarily sealed.

7.4.4 Perform the retest of the sealing test on the sample in accordance with Chapter 6.

7.5 Result judgment

After the test, visually inspect the light-transmitting parts of the sample; there shall be no cracks and bubbles. During the retest of the sealing test, visually inspect the sample at the bonding, welding, joints; there shall be no bubbles.

8 Thermal deformation test

8.1 Applicability

This test is applicable to lighting devices and light signaling devices; it is used to evaluate the heat resistance of their plastic parts to the environment and their own light sources.

8.2 Number of samples

2 lighting devices or 2 light signaling devices.

8.3 Test conditions

8.3.1 The sample shall be initially and retested for the sealing test before and after the test.

8.3.2 The test is carried out in a temperature test chamber; the airflow in the chamber shall be 0.5 m/s ~ 2 m/s. Temperature conversion rate: 1.0 °C/min ~ 4.0 °C/min.

8.3.3 The sample is placed in the test chamber in a simulated normal working position and is placed in the middle of the chamber as far as possible. The reference axis should be parallel to and face the main direction of the circulating airflow. The distance between the sample and the chamber wall shall be greater than 100 mm.

8.3.4 The temperature in the sample chamber is set according to the function and installation position of the lamp, which shall meet the requirements of Table 1.

9 Salt spray test

9.1 Applicability

This test is applicable to external lighting devices and light signaling devices, to evaluate their resistance to salt spray corrosion.

9.2 Number of samples

2 lighting or 2 light signaling devices.

9.3 Test conditions

9.3.1 Protect the samples to simulate the actual installation conditions and place them in the test chamber, to ensure that the reference axis remains horizontal.

9.3.2 The mass concentration of the sodium chloride salt solution is 50 g/L ± 5 g/L; the pH (at 35 °C ± 2 °C) is 6.5 ~ 7.2.

9.3.3 The test chamber temperature is 35 °C ± 2 °C; the salt spray deposition rate is (1.5 mL ± 0.5 mL)/(80 cm^2 • h); continuous spraying is possible.

9.4 Test method

9.4.1 Place the samples in the test chamber to simulate the actual installation conditions.

9.4.2 Spray continuously for 23 h and stop spraying for 1 h in each cycle. The test shall end at the stop spraying stage. Devices with front lighting function shall undergo 10 cycles of testing. Devices with only light signaling function shall undergo 2 cycles of testing.

9.4.3 After the test, wash off the salt stains attached to the sample surface with deionized water and dry under natural convection conditions.

9.5 Result judgment

There shall be no visible changes on the surface of the internal parts of the sample, no visible base corrosion on the external metal parts.

10 Dustproof test

10.1 Applicability

This test is used to evaluate the dustproof performance of external lighting and light signaling devices.

10.2 Equipment

test bracket; the bracket shall be fixed on the rotating table of the equipment. The test table's rotation speed is 1 r/min ~ 3 r/min.

13.5.3 The test consists of two cycles, each cycle lasting 5 min, of which 3 min is for lighting the sample (lighting all functions that can work simultaneously) and 2 min is for turning it off. The test duration is 10 min.

13.6 Result judgment

After the test, there shall be no water or fog in the sample. If fog is generated in the light distribution lens, the sample shall be lit at room temperature with the test voltage. If the fog disappears within 2 hours, it is considered to meet the requirements.

14 Test for resistance to lubricating oil, fuel, cleaning fluid

14.1 Applicability

This test is applicable to external light signaling devices and is used to evaluate the effects of chemical reagents on plastic light distribution lens.

14.2 Reagents

The following test fluids are used in the test:

- Clean lubricating oil;
- Fuel, composed of 70% n-heptane and 30% toluene by volume;
- Windshield washer fluid, composed of 1 part of distilled water and 1 part of concentrated cleaning fluid. The volume fraction of the concentrated cleaning fluid is: 85% isopropanol, 5% ethanol, 0.32% ethanolamine, adding distilled water to 100%.

14.3 Number of samples

2 light signaling devices need to be tested for each test fluid.

14.4 Test conditions

14.4.1 The test shall be conducted in an environment of 23 °C ± 5 °C.

14.4.2 The concentrated cleaning fluid shall be prepared at the test site.

14.5 Test method

14.5.1 Before the test, perform an initial test on the photometric value change of the sample according to 4.4. For the test on resistance to lubricating oil, fuel oil, cleaning fluid, the following method A or method B can be selected according to the actual use

of the manufacturer's product.

- Method A: Contains two tests, 14.5.2 and 14.5.3.

- Method B: Contains three tests, 14.5.2, 14.5.3, 14.5.4.

14.5.2 Lubricating oil resistance test: Use a piece of cotton cloth soaked in clean lubricating oil to wipe the outer surface of the sample's light distribution lens to make it wet; wipe the surface clean after about 5 minutes; visually inspect the outer surface of the light distribution lens. Perform the first retest on the photometric value change of the sample according to 4.4.

14.5.3 Fuel resistance test: Use a cotton cloth soaked in fuel to wipe the outer surface of the sample light distribution lens to make it wet; wipe the surface clean after about 5 minutes; visually inspect the outer surface of the lens. According to 4.4, retest the photometric value change of the sample for the second time.

14.5.4 Cleaning fluid resistance test: Use a cotton cloth soaked in cleaning fluid to wipe the outer surface of the sample light distribution lens to make it wet; inspect the outer surface of the lens after 7 hours.

14.6 Result judgment

After the test, the outer surface of the light distribution lens shall be free of cracks, discoloration, and deformation. After the lubricating oil resistance test, the photometric value of the sample changes by no more than 20%. After the fuel resistance test, the photometric value of the sample changes by no more than 20%.

15 Light source irradiation test

15.1 Applicability

This test is applicable to lighting devices (except headlights and front fog lights) and light signaling devices installed on the outside of the vehicle; it is used to evaluate the light source irradiation resistance of its plastic optical components.

15.2 Equipment

Weather aging test chamber: The spectral energy distribution of the light source is similar to that of a black body with a temperature of 5500 K ~ 6000 K.

15.3 Number of samples

4 new plastic lens samples, 3 of which are used for testing and 1 for backup.

15.4 Test conditions and methods

15.4.1 In the test chamber, the temperature of the black mark at the same horizontal position as the sample is 60 °C ± 5 °C.

15.4.2 A corresponding filter shall be placed between the light source and the sample, to minimize the influence of radiation with a wavelength less than 290 nm and greater than 2500 nm.

15.4.3 The sample rotates around the light source at a speed of 1 r/min ~ 5 r/min.

15.4.4 The irradiance is set to 1000 W/m^2 ± 100 W/m^2; the radiant energy received during the irradiation period is 4500 MJ/m^2 ± 200 MJ/m^2.

15.4.5 During the test, the samples shall be sprayed for 5 minutes and illuminated for 25 minutes; the cycle shall be repeated until the end of the test. The conductivity of the distilled water used for spraying is less than 1 mS/m at 23°C ± 2.5 °C.

15.4.6 The backup samples shall be kept away from light and dust, for comparison with the samples after the test.

15.5 Result judgment

15.5.1 After the test, the outer surface of the sample shall be free of cracks, scratches, chips, deformation.

15.5.2 According to the measurement method of diffuse light and transmitted light in GB 4599, the transmitted light of the 3 samples is measured; the average value Δt_m of the transmittance change Δt [$\Delta t = (T_2 - T_3)/T_2$] shall not be greater than 0.020.

16 Fog test

16.1 Applicability

This test is applicable to lighting devices and light signaling devices; it is used to evaluate the fog condensation inside them under complex environmental conditions.

16.2 Equipment

16.2.1 The equipment shall have two test chambers with independent temperature and humidity control, simulating the environment of the mask (light distribution lens) and lamp housing when the lamp is installed on the whole vehicle, namely the mask chamber and the lamp housing chamber, as shown in Figure 9. The temperature control range of the test chamber covers 0 °C ~ 100 °C; the relative humidity is 5% ~ 98%.

parts in an environment at a temperature of 80 °C ± 4 °C and a relative humidity of less than 10%, for at least 12 hours.

16.5.3 Install the disassembled parts and place the lamp sample in an environment with a temperature of 23 °C ± 2 °C and a relative humidity of 60% ~ 80%, for at least 12 hours.

16.5.4 Place the sample between the mask chamber and the lamp housing chamber in a simulated installation state; use baffles or insulation materials to separate the test environment of the front and rear parts of the sample.

16.5.5 For headlamps, front fog lamps and other lamps installed only at the front of the vehicle, increase the lamp housing chamber temperature to 70 °C ± 4 °C at a heating rate greater than 2 °C/min and not greater than 4 °C/min; the relative humidity is 5% ~ 15%. For lamps installed in other parts, increase the lamp housing chamber temperature to 50 °C ± 4 °C at a heating rate greater than 2 °C/min and not greater than 4 °C/min; the relative humidity is 5% ~ 15%. For all lamps, the temperature of the mask chamber is 20 °C ± 4 °C; the relative humidity is 70% ~ 80%.

16.5.6 Light the lamp; start to spray water evenly on the surface of the lamp's light distribution lens. There is no requirement for the humidity of the mask chamber after spraying water.

16.5.7 Continue to observe the fog formation in the lamp's light distribution lens. It can stop spraying for a short time every 5 minutes after the start of water spraying; observe and record; the pause observation time is included in the test time. The pause time of each water spraying shall not exceed 45 s. Record the time from the start of water spraying to the formation of fog. Stop spraying water after 60 minutes.

16.5.8 If there is fog in the light distribution lens after the water spraying is finished, mark the fog condensation area on the surface of the light distribution lens; place the sample at room temperature; light it according to the requirements of 16.4.2; leave it for 120 minutes; observe and record the dissipation of fog.

16.6 Result judgment

After the test, it is judged as qualified if the following requirements are met.

- Within 20 minutes after the start of water spraying, there shall be no fog, water droplets or water accumulation on the inner surface of the light distribution lens. After the water spraying is completed, there shall be no condensed water droplets or water accumulation in the light distribution lens.

- After the water spraying is completed, there shall be no fog on the inner surface of the light distribution lens; if there is fog in the light distribution lens, the fog shall be dissipated after the operation in accordance with 16.5.8.

The corresponding model shall have passed the highly accelerated life stress test or obtained the working limit and destruct limit of the product.

This test is mainly used to monitor the consistency of the product process and eliminate defective products.

18.2 Equipment

Meet the requirements of 17.2. The test shall use the same type of equipment used in the previous highly accelerated life test.

18.3 Number of samples

All products that have passed the production line inspection. Or a certain number of samples can be randomly selected, according to the manufacturer's requirements.

18.4 Test conditions

18.4.1 The specimen shall be mounted on a rigid, lightweight test fixture to fix the test bracket on the test box table. The test bracket shall have a good vibration transmission effect, to ensure that the vibration magnitude transmitted to the sample reaches 70% or more of the set vibration magnitude of the table, meanwhile does not affect the heat conduction of the sample.

18.4.2 Select one or more samples; fix the temperature sensor to the key part of the sample to monitor and record the temperature parameters.

18.4.3 Select one or more samples; fix the vibration sensor to the key part of the sample to monitor and record the vibration magnitude. The size and mass of the sensor shall be small enough, to avoid changing the response characteristics of the measured part.

18.4.4 When the set temperature exceeds room temperature during the test, all functions on the lamp shall be lit (lit at the maximum power under normal use, for example, when the daytime running lamp is combined with the headlight, the daytime running lamp does not need to be lit).

18.4.5 Unless the product is not applicable or the lamp is not lit during this test phase, the current and voltage of the sample shall be monitored during the test. This monitoring can be performed after the temperature of each measuring part reaches stability, or it can be performed throughout the test.

18.5 Test method

18.5.1 Screening confirmation

Confirm the working limit and destruct limit determined by the highly accelerated life test of the sample in the early stage.

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