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**Measuring Method for Electric and Photometric Parameters
of Filament Light Sources for Power-driven Vehicles**

机动车用灯丝光源光电参数测量方法

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Measuring Method for Electric and Photometric Parameters of Filament Light Sources for Power-driven Vehicles

1 Scope

This document specifies the measurement principles, instruments and equipment, measurement conditions, measurement steps, data processing, and test reports of the electric and photometric parameters, total flux, and chromaticity coordinates of filament light sources for power-driven vehicles.

This document is applicable to filament light sources used for power-driven vehicle road lighting and light signal devices and systems (hereinafter referred to as the “light sources”). Filament light sources used for other road vehicles may take this as a reference.

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 2900.65 Electrotechnical Terminology - Lighting

GB/T 26178 The Measurement of Luminous Flux

GB/T 43081-2023 Lamps and Light Sources for Road Vehicles - Dimensional, Electrical and Luminous Requirements

JJG 247-2008 Standard Incandescent Lamp for Total Luminous Flux

3 Terms and Definitions

The terms and definitions defined in GB/T 2900.65 and GB/T 26178, and the following are applicable to this document.

3.1 filament light sources

A type of light sources, in which, the only element that generates and emits light when powered is one or multiple filaments.

3.2 test voltage

U

- b) The grade index is not lower than 0.01% and the rated power is not lower than 1 W.

5.2 Total Flux

5.2.1 Integrating sphere

The integrating sphere shall comply with the following requirements.

- a) Diameter of the integrating sphere: while taking into account the photoelectric responsivity, the size of the integrating sphere shall be large enough to avoid relatively large errors caused by uneven distribution of the integrating sphere response due to the accessories inside the integrating sphere and the light source under test. The diameter of the integrating sphere is not less than 1.0 m.
- b) Accessories and coating of the integrating sphere: all accessories inside the sphere will affect the measurement results. Accessories (such as screens, wires and light source brackets, etc.) shall be as small and as few as possible. The inside of the sphere and the surface of its accessories shall be coated with a white coating, which has good chemical stability and neutral spectral diffuse reflection characteristics, and a reflectivity of not less than 85%.
- c) Layout of light source and screen: usually the center of the light source filament is placed at the center of the sphere, and the center of the screen is on the line connecting the center of the sphere and the center of the detector window, at a distance of $2/3$ of the radius of the sphere from the center of the sphere, and the surface of the screen is perpendicular to the line. The function of the screen is to prevent the light of the light source from directly irradiating the detector. On this premise, the screen shall be as small as possible.
- d) Auxiliary light source: the integrating sphere is equipped with an auxiliary light source to perform absorption measurements. The auxiliary light source emits radiation that covers the entire visible light wavelength range. The auxiliary light source also has a screen to prevent its direct light from irradiating the detector or the light source under test.

5.2.2 Photometer

The photometer shall comply with the following requirements:

- a) The detector of the photometer has stable performance, high sensitivity, good linearity and fast response. The spectral sensitivity of the combination of the correction light filter and the integrating sphere conforms to the spectral luminous efficiency function $V(\lambda)$ of the CIE photopic standard photometric observer;
- b) The grade of the photometer is not lower than Grade 1, and the number of significant digits read is not less than 4.

5.2.3 Spectroradiometer

The spectroradiometer shall comply with the following requirements:

- a) The spectral wavelength range covers at least 380 nm ~ 780 nm;
- b) The wavelength error is within ± 0.2 nm;
- c) The non-linear error of the instrument is within $\pm 1\%$ (A light source);
- d) The bandwidth (full width at half maximum) and scanning interval are not greater than 5 nm;
- e) The relative spectral power distribution indication error is within $\pm 2\%$.

5.2.4 Standard lamp

The standard lamp should be a standardized (for example: the BDX series) small total flux standard incandescent lamp, or a light source that has been screened by ageing from conventional filament light source products for power-driven vehicles.

The ageing screening process is as follows:

- a) From conventional products, select several light sources with glass bulbs free of bubbles or scratches, and with good filaments, lamp holders and overall appearance;
- b) After ageing as described in 6.2, at the test voltage, measure the initial value of the total flux and the current;
- c) At the test voltage, keep the power on for 10 hours, control the initial current, and measure its total flux. Calculate the relative deviation from the initial value, and keep the light sources with a deviation within $\pm 0.8\%$ and proceed with the next step of test;
- d) Repeat step c), until the total power-on ageing time reaches 30 hours, and retain the light sources that meet the ageing screening conditions for measurement.

There shall be no less than 3 standard lamps of each specification, and the level of the standard lamps shall at least comply with Level 2 in JJG 247-2008.

The standard lamps shall be stored in a room temperature, dry and vibration-free environment without corrosive gases, and shall be protected from impact and overload during use.

5.3 Chromaticity Coordinates

5.3.1 Spectroradiometer

The spectroradiometer shall comply with the requirements of 5.2.3.

5.3.2 Standard lamp

Standard lamps shall comply with the requirements of 5.2.4.

5.4 Instrument and Equipment Traceability

The standard lamps and instruments shall be verified or calibrated by a metrology institution and used within their validity period.

6 Measurement Conditions

6.1 Working Environment

The measurement of light sources shall be carried out in an environment with a temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and a humidity of less than 80%. Temperature control equipment (such as: air conditioners, heaters, etc.) shall not be placed in a location that allows airflow and radiant heat to be directly transmitted to the thermometer or photometer.

6.2 Ageing

Before measurement, use the test voltage to continuously ignite for 1 h to age the light source. For dual-filament light sources, each filament shall be respectively aged. For light sources for which multiple test voltages are specified, the highest test voltage value shall be used.

During ageing, the light source reference axis and the filament are in a horizontal state. For a dual-filament light source equipped with a light distribution screen, the light distribution screen shall be located below the low-beam filament. If the light source has an axial filament, the longer filament support shall be located above the filament.

6.3 Ignition Location and Direction

When measuring the total flux, the light source shall be located at the center of the integrating sphere, and its direction is:

- a) The reference axis and the filament are in a horizontal state, and the filament axis is parallel to the screen;
- b) For light sources with transverse filaments (the filament axis is perpendicular to the reference axis), the top of the glass bulb faces the screen;
- c) For light sources with axial filaments (the filament axis is parallel to the reference axis), the longer filament support shall be located above the filament;
- d) For light sources with a light distribution screen and emitting asymmetric light, the light distribution screen shall be located below the low-beam filament and the side of the light distribution screen edge with an inclined angle faces the screen.

Examples of the ignition directions of different types of light sources within the sphere are provided in Appendix A.

6.4 Stabilization

Stabilization means that the parameters of the light source do not significantly change within a certain period of time. During stabilization and measurement, the operating environment of the light source shall be the same. Before each measurement, the halogen light source shall be ignited at the test voltage for 4 minutes ~ 5 minutes, and other light sources shall be ignited at the test voltage for 2 minutes ~ 3 minutes, all light sources shall be ignited for 10 min when measuring the chromaticity coordinates. During the last minute of the ignition of the light source, the light output is measured every 20 seconds. When the deviation between the maximum and minimum values of the three readings is within 0.25%, stabilization is achieved. If the requirement is still not met after 15 minutes, the test can be started and the observed fluctuations shall be recorded.

6.5 Voltage and Current

When measuring voltage, the voltmeter wiring should be drawn from both ends of the lamp holder near the filament position of the light source to monitor the voltage at the lamp end of the light source under test. When measuring current with power on, a component with a relatively small contact resistance shall be used to clamp the lamp holder of the light source, for example, a special lamp holder for measurement, to reduce the contact resistance and measurement errors. Typical examples of light source power-on and lamp holder voltage monitoring are shown in Appendix B.

Voltage and current tests use the four-wire line power supply.

7 Measurement Steps and Data Processing

7.1 Pre-heating of Measurement Equipment

Before measuring electric and photometric parameters, the equipment shall be turned on for pre-heating, so as to stabilize its performance. If the total flux is to be measured, a light source with a power similar to that of the light source under test shall be ignited in the integrating sphere for not less than 30 minutes, the sphere wall shall be baked to de-humidify, and the detector shall be pre-illuminated.

7.2 Measurement of Electric Parameters

The measurement steps are as follows.

- a) After the light source under test has been aged in accordance with the requirements of 6.2, install it to the center of the sphere in the mode of 6.3 and in accordance with the provisions of 6.5, connect it to the measurement system shown in Figure 1 or Figure 2. Adjust the power output, so that the reading of the V_2 meter is the test voltage. After the light source reaches the stabilization described in 6.4, respectively read the displayed values u and U of the V_1 and V_2 voltmeters in Figure 1 or read the voltmeter reading U and the ammeter reading I in Figure 2. The voltage adjustment process shall

- d) In accordance with Formula (7), calculate the total flux of the light source under test:

$$\Phi_n = \Phi_t \times \frac{\sum_{380}^{780} V(\lambda) p_n(\lambda) \Delta\lambda}{\sum_{380}^{780} V(\lambda) P_t(\lambda) \Delta\lambda} \dots\dots\dots (7)$$

Where,

Φ_n ---the total flux of the light source under test;

Φ_t ---the total flux of the standard lamp;

$p_n(\lambda)$ ---the relative spectral power distribution of the light source under test;

$P_t(\lambda)$ ---the relative spectral power distribution of the standard lamp;

$V(\lambda)$ ---the spectral luminous efficiency function of the CIE photopic standard photometric observer;

$\Delta\lambda$ ---the wavelength test interval of the (relative) spectral power distribution of the light source.

7.3.3 Total flux absorption correction factor

When the overall dimensions of the standard lamp and the light source under test greatly differ or the glass bulb form and lamp holder shape are obviously different, an auxiliary light source shall be used to measure the absorption correction factor k of each type of light source under test. The method shall comply with the provisions of Appendix C. After the absorption correction, the total flux Φ of the light source under test is calculated in accordance with Formula (8):

$$\Phi = \Phi_n \cdot k \dots\dots\dots (8)$$

7.4 Measurement of Chromaticity Coordinates

7.4.1 The measurement is carried out in a dark room or dark box. The dark room or dark box shall have no light leakage and be well sealed and dustproof. The entire space should be set with low-reflectivity materials, such as: matte black or matte gray. Measures shall be taken to ensure that the photometer detector is not affected by reflected light from objects in the space. When getting ready to measure, the stray light received by the photometer detector is not greater than 0.005 lx.

7.4.2 The chromaticity coordinates are measured using a spectroradiometer with the detector measuring within a right cone subtended by a minimum of 5° and a maximum of 15°, with the apex of the cone located at the center of the filament.

7.4.3 Place the standard lamp in a dark room or dark box and in the same method as in 7.3.2 a), calibrate the spectroradiometer.

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