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**Method of Measuring the Colour Rendering Properties
of Light Source**

光源显色性评价方法

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Method of Measuring the Colour Rendering Properties of Light Source

1 Scope

This Standard specifies the general requirements for the evaluation on colour rendering of light source, the measurement of spectral power distribution of light source and the calculation of colour rendering.

This Standard is applicable to the evaluation of the colour rendering of light sources that meet the requirements of white light sources.

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) is applicable to this document.

GB/T 5700 Measurement Methods for Lighting

GB/T 7922 Method of Measuring the Colour of Light Sources

CIE 127 Measurement of LECs

3 Terms and Definitions

For the purposes of this Document, the following terms and definitions apply.

3.1 Colour rendering of a light source

The influence of the light source spectrum on the colour appearance of the object. This influence is caused by the observer intentionally or unintentionally comparing it with the colour appearance under the reference illuminator.

3.2 Colour rendering index

The colour fidelity that reflects the colour rendering of the light source. It is expressed by the degree of coincidence between the colour of the object under the light source

5.1.5 The measurement light repeatability of the spectroradiometer shall be better than 1%.

5.2 Measurement methods

5.2.1 When measuring the colour rendering of the light source in the laboratory, the light source (relative) spectral power distribution shall comply with the measurement methods of spectral irradiance, total spectral radiant flux, partial spectral radiant flux and spectral radiance specified by CIE127.

5.2.2 When measuring the colour rendering of the light source on site, the light source (relative) spectral power distribution shall conform to the measurement methods of spectral irradiance and spectral radiance specified in GB/T 5700.

5.3 Laboratory test conditions

5.3.1 The ambient temperature shall be $(23 \pm 2) ^\circ\text{C}$, and the relative humidity of the environment shall be no greater than 65%.

5.3.2 The light source to be measured shall be tested under rated conditions, and the power supply equipment shall comply with the following provisions:

- a) The harmonic content of the A.C. input voltage shall be less than 3%, and the deviation of the power frequency from the rated value shall not exceed 0.5%;
- b) The uncertainty of the input voltage and current monitoring equipment shall not exceed 0.2%.

5.3.3 Before measuring the colour rendering of the light source, the light source shall be preheated.

5.3.4 The test site shall be free of ambient light that affects the test results.

6 Calculation of Colour Rendering

6.1 Calculation process of light source colour rendering

The calculation shall be carried out according to the calculation process specified in Figure 1.

$\dot{u}_{k,i}$, $\dot{v}_{k,i}$ - after the chromaticity shift is corrected, the chromaticity coordinate of the i^{th} colour sample under the light source to be measured.

c_r , d_r - adaptive chromaticity shift of the reference illuminator, which shall be calculated by Formulas (20) and (21) by the uv chromaticity coordinate of the reference illuminator;

c_k , d_k - adaptive chromaticity shift of the light source to be measured, which shall be calculated by Formulas (20) and (21) by the uv chromaticity coordinate of the light source to be measured;

$c_{k,i}$, $d_{k,i}$ - adaptive chromaticity shift of the i^{th} colour sample, which shall be calculated by Formulas (20) and (21) by u , v chromaticity coordinate of the i^{th} colour sample irradiated under the light source to be measured:

$$c = \frac{1}{v}(4 - u - 10v) \quad \dots\dots\dots (20)$$

$$d = \frac{1}{v}(1.708v + 0.404 - 1.481u) \quad \dots\dots\dots (21)$$

6.3.4 U^* , V^* , W^* chromaticity parameters of the colour sample irradiated under light source shall be calculated by Formulas (22), (23) and (24):

$$W^* = 25Y^{\frac{1}{3}} - 17 \quad \dots\dots\dots (22)$$

$$U^* = 13W^*(u - u_0) \quad \dots\dots\dots (23)$$

$$V^* = 13W^*(v - v_0) \quad \dots\dots\dots (24)$$

Where:

u , v - uv chromaticity coordinate of colour sample;

u_0 , v_0 - uv chromaticity coordinate of reference illuminator.

6.4 Calculation of colour rendering

6.4.1 The colour difference ΔE of the colour sample irradiated by the light source to be measured and reference illuminator shall be calculated by Formula (25):

$$\Delta E = [(W_{r,i}^* - W_{k,i}^*)^2 + (U_{r,i}^* - U_{k,i}^*)^2 + (V_{r,i}^* - V_{k,i}^*)^2]^{\frac{1}{2}} \quad \dots\dots\dots (25)$$

6.4.2 The special colour rendering index R_i corresponding to each colour sample shall be calculated by Formula (26):

$$R_i = 100 - 4.6\Delta E_i \quad \dots\dots\dots (26)$$

Appendix A

(Informative)

Other Evaluation Index and Calculation Method of Colour

Rendering of Light Source

A.1 The necessity of supplementary evaluation index

Colour rendering index is an evaluation method based on the influence of light source on colour fidelity. However, this method does not reflect the influence of factors such as the increase in saturation caused by the colour difference of the colour sample caused by the light source on human perception.

A.2 Calculation of the gamut area index of the light source

A.2.1 The colour gamut of the light source shall be calculated by Formula (A.1) according to the standard colour samples specified in Table B.1; U^* , V^* shall be calculated according to 6.3:

$$G = 0.5 \cdot [(U_1^* \cdot V_2^* - U_2^* \cdot V_1^*) + (U_2^* \cdot V_3^* - U_3^* \cdot V_2^*) + (U_3^* \cdot V_4^* - U_4^* \cdot V_3^*) + (U_4^* \cdot V_5^* - U_5^* \cdot V_4^*) + (U_5^* \cdot V_6^* - U_6^* \cdot V_5^*) + (U_6^* \cdot V_7^* - U_7^* \cdot V_6^*) + (U_7^* \cdot V_8^* - U_8^* \cdot V_7^*) + (U_8^* \cdot V_1^* - U_1^* \cdot V_8^*)] \quad \dots\dots (A.1)$$

A.2.2 The colour gamut index G_a of light source to be measured can be calculated according to Formula (A.2):

$$G_a = 100 \cdot \frac{G_k}{G_r} \quad \dots\dots\dots (A.2)$$

Where:

G_k – colour gamut of the light source to be measured;

G_r – colour gamut of the reference illuminator.

A.3 Calculation of chromaticity index of the light source

A.3.1 The chromaticity index of the light source can be calculated based on the standard colour samples specified in Appendix B or the non-standard colour samples determined by the user.

A.3.2 The chromaticity $C_{k,i}^*$ of the colour sample irradiated by the reference illuminator shall be determined according to the provisions of 5.2 of GB/T 7921-2008 as per the tristimulus values of X_i , Y_i and Z_i calculated in accordance with provisions of 6.3.1.

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