



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Paper and board - Determination of colour (D50/2° diffuse
reflectance method)**

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1 Scope

This document describes a method for determining the color of paper and cardboard by the diffuse reflectance method with the elimination of gloss.

This document applies to paper and cardboard for printing.

When the amount of ultraviolet radiation irradiated by the light source of the instrument on the sample is adjusted to be consistent with the fluorescence reference standard under CIE illuminant C provided by the authorized laboratory specified in GB/T 40277, this method can be used for the determination of the color of paper and cardboard that contains fluorescent whitening.

This document does not apply to paper and cardboard to which fluorescent dyes or color dyes have been added.

2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions of this document. For the dated referenced documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments)

is applicable to this document.

GB/T 450 Paper and board - Sampling for testing and identification of machine and cross direction, wire side and felt side (GB/T 450-2008, ISO 186: 2002, MOD)

GB/T 3977 Specification of colors (GB/T 3977-2008, CIE 15: 2004, NEQ)

GB/T 10739 Paper, board and pulps - Standard atmosphere for conditioning and testing (GB/T 10739-2002, ISO 187: 1990, EQV)

GB/T 40277 Paper, board and pulps - Measurement of diffuse blue reflectance factor (ISO brightness) - Indoor daylight conditions (GB/T 40277-2021, ISO 2470-1: 2016, MOD)

ISO 2469 Paper, board and pulps - Measurement of diffuse radiance factor (diffuse reflectance factor)

of the sample.

Note: The reflectance factor of a transparent specimen depends on the backing, not material properties.

3.5 X, Y, Z tristimulus values

In a given trichromatic system, the amounts of three reference color stimuli that match the color of the stimulus under study.

Note 1: In this document, the CIE illuminant D50 and CIE 1931 (2°) standard observer are used for defining the trichromatic system.

Note 2: According to CIE convention, when the CIE 1931 (2°) standard observer is used, the obtained tristimulus values have no subscript [when the CIE 1964 (10°) standard observer is used, the obtained tristimulus values have the subscript 10].

3.6 CIELAB colour space

The approximately uniform three-dimensional colour space that is drawn by rectangular coordinates, and the magnitudes of L^* , a^* , and b^* are specified by the formulas given in Chapter 9.

Note: The value of L^* represents the measured brightness of the sample, $L^*=0$ corresponds to the sample that is black, and $L^*=100$ corresponds to the sample that is a perfect diffuse reflection surface. The values of a^* and b^* represent the red-green and yellow-blue directions on the coordinates, respectively. Thus, $+a^*$ is a measure of the redness of the sample;

$-a^*$ is a measure of the greenness of the sample;

$+b^*$ is a measure of the yellowness of the sample;

-b* is a measure of the blueness of the sample.

If both a* and b* are 0, the sample is gray.

4 Principles

Under the specified ultraviolet irradiation conditions, a tristimulus filter-type reflection photometer or an abridged spectrophotometer is used to analyze the reflected light on the sample, and the color coordinates under the condition of D50/2° are calculated.

5.1.1 General rules

The geometric, spectral, and photometric characteristics of the reflection photometer shall comply with the provisions of ISO 2469, and it shall be calibrated according to ISO 2469.

As described in GB/T 40277, when samples containing fluorescent brighteners are tested, the reflectance photometer shall be equipped with a radiation source with adjustable UV content. The UV conditions shall be adjusted to be consistent with the CIE illuminant C with the use of a reference standard.

5.1.2 Filter-type reflectance photometer

For a filter-type reflectance photometer, the overall response given by the combination of filters and the instrument's optical characteristics is equivalent to the CIE tristimulus values X, Y, and Z of the sample under the conditions of CIE illuminant D50 and CIE 1931 standard colorimetric system.

When a filter-type reflectance photometer is used, the UV content irradiated on the sample shall be consistent with that of the CIE illuminant C.

5.1.3 Abridged spectrophotometer

When the samples are tested under CIE illuminant D50 with an abridged spectrophotometer, one of the functions allows the CIE tristimulus values X, Y, and Z of the tested sample under the conditions of CIE illuminant D50 and CIE 1931 standard colorimetric system is calculated with the weighted coefficient. Appendix A gives the weighting functions required for the calculations. Among them, Table A.1 and Table A.2 are used for instruments without a bandpass correction function, and Table A.3 and

Table A.4 are used for instruments with a bandpass correction function.

When an abridged spectrophotometer is used, the instrument shall have a UV tunable filter with a cut-off wavelength of 395 nm or other equivalent systems. The filter shall be adjusted, or the system shall be calibrated with the fluorescence reference standard (5.2.3), so that the UV content irradiated to the sample is consistent with that of the CIE illuminant

C.

5.2.1 General rules

A reference standard, which is applied for the instrument calibration and the working standards, shall be used frequently to ensure that the requirements of the instrument and UV calibration can be met.

5.2.2 Non-fluorescent reference standard

It is used for photometric calibration and shall be provided by an authorized laboratory top and bottom of the stack to protect the samples. Avoid contamination and unnecessary exposure to light or heat.

Make a mark on one corner of the sample to identify the sample and distinguish between the top and wire sides.

If the top side can be distinguished from the wire side, the top side shall be facing up.

If the top and wire sides of the sample cannot be distinguished, such as paper produced by a twin-wire paper machine or coated on both sides, it shall be ensured that the same sides of paper samples are facing up, to ensure that each side of the paper and cardboard can be measured separately.

8 Test steps

8.1 Ensure that the instrument is calibrated in accordance with the requirements of GB/T 40277 and the instrument manufacturer's instructions.

8.2 Remove the protective sheets on the top and bottom of the sample stack, do not touch the test area with hands, and measure the CIE tristimulus value (or CIELAB value, if the instrument is designed to report the colour space directly) of the first sample according to the operating method of the instrument. Read and record the tristimulus values, and the values shall be accurate to 0.01.

8.3 Remove the uppermost sample and place it under the sample stack to test the value of the next sample. Test the remaining samples in the same way until at least 10 samples have been tested. If necessary, repeat the above procedure to test the other sides of the samples.

9 Result calculation

9.1 CIE tristimulus values If the bandpass of the instrument is equal to or less than 5 nm, the CIE tristimulus value is calculated according to GB/T 3977. In addition, the CIE tristimulus values are calculated according to the corresponding weighting function given by ASTM E308. If the CIE tristimulus value is not directly provided by the instrument, it can be calculated according to the tables given in Appendix A.