
**Paper and board — Determination of colour
(C/2°) — Diffuse reflectance method**

*Papier et carton — Détermination de la couleur (C/2°) — Méthode par
réflectance diffuse*

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Printed in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 5631 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

Annex A forms a normative part of this International Standard.

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Introduction

The colour of an object can be uniquely characterized by means of a triplet of colour coordinates such as the 1931 CIE tristimulus values, the CIELAB 1976 L^* , a^* , b^* coordinates or the dominant wavelength, excitation purity and luminous reflectance.

The values of such coordinates depend upon the conditions of measurement, particularly the spectral and geometric characteristics of the instrument used. This International Standard should therefore be read in conjunction with ISO 2469.

This method describes the measurement and description of colour in terms of the CIE illuminant C and the CIE 1931 (2°) standard observer. The measurement and calculations can be carried out in an analogous manner with respect to the CIE standard illuminant D65 and the CIE 1964 (10°) standard observer or with other illuminant/observer combinations, but this is not in accordance with this International Standard.

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Paper and board — Determination of colour (C/2°) — Diffuse reflectance method

1 Scope

This International Standard specifies a method for measuring the colour of paper and board by the diffuse reflectance method with the elimination of specular gloss.

This International Standard is not applicable to coloured papers or boards which incorporate fluorescent dyes or pigments. It may be used to determine the colour of papers or boards which contain fluorescent whitening agents provided the UV-content of the illumination on the test piece has been adjusted to conform to that in the CIE illuminant C using a fluorescent reference standard provided by an authorized laboratory as described in ISO 2470.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 186:1994, *Paper and board — Sampling to determine average quality*.

ISO 2469, *Paper, board and pulps — Measurement of diffuse reflectance factor*.

CIE Publication 15.2:1986, *Colorimetry*.

ASTM E 308-95, *Standard Practice for Computing the Colors of Objects by Using the CIE System*.

3 Terms and definitions

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

3.1 reflectance factor

R

ratio of the radiation reflected by a body to that reflected by the perfect reflecting diffuser under the same conditions of illumination and detection

NOTE 1 The reflectance factor is expressed as a percentage.

NOTE 2 The reflectance factor is influenced by the backing if the body is translucent.

3.2

intrinsic reflectance factor

R_{∞}

reflectance factor of a layer or pad of material thick enough to be opaque, i.e. such that increasing the thickness of the pad by doubling the number of sheets leads to no change in the measured reflectance factor

3.3

tristimulus values

X, Y, Z

amounts of the three reference colour stimuli, in a given trichromatic system, required to match the stimulus considered

NOTE In this International Standard, the CIE 1931 standard observer and the CIE illuminant C are used to define the trichromatic system.

3.4

CIELAB colour space

three-dimensional approximately uniform colour space, produced by plotting, in rectangular coordinates, L^* , a^* , b^* quantities defined by the equations given in clause 9

4 Principle

The light reflected from a sample under specified conditions is analysed either by a tristimulus-filter colorimeter or by an abridged spectrophotometer, and the colour coordinates are then calculated.

5 Apparatus

5.1 Reflectometer, having the geometric, spectral and photometric characteristics described in ISO 2469 and calibrated in accordance with the provisions of ISO 2469.

NOTE In the 1994 edition of ISO 2469 the reflectometer characteristics are described in annex A and the calibration service is described in annex B. When ISO 2469 is revised, the numbering may change; users of editions subsequent to 1994 should therefore determine which elements of text specify these characteristics and this service.

5.2 Filter-function

In the case of a filter reflectometer, a set of filters that, in conjunction with the optical characteristics of the basic instrument, give overall responses equivalent to the CIE tristimulus values X, Y and Z of the CIE 1931 standard colorimetric system of the test piece evaluated for the CIE illuminant C.

In the case of an abridged spectrophotometer, a function that permits calculation of the CIE tristimulus values X, Y and Z of the CIE 1931 standard colorimetric system of the test piece evaluated for the CIE illuminant C using the weighting functions given in annex A.

5.3 Reference standards, issued by an ISO/TC 6 authorized laboratory in accordance with the provisions of ISO 2469 for calibration of the instrument and the working standards. For maximum accuracy, reference standards having assigned values within the maximum range expected for the particular product to be tested should be selected.

If there is reason to suspect that the instrument has poor linearity or that the deviations from the true colour matching and observer functions are greater than can be tolerated, the use of product-specific reference standards should be considered.

5.4 Working standards, calibrated in the instrument concerned against ISO reference standards of level 3 supplied by an authorized laboratory (see ISO 2469). Calibrate the working standards sufficiently frequently to ensure that satisfactory calibration is maintained.

Use newly calibrated reference standards sufficiently frequently to ensure that the reflectometer is maintained in agreement with the reference instrument.

5.5 Black cavity, having a reflectance factor which does not differ from its nominal value by more than 0,2 %, at all wavelengths. The black cavity should be stored upside down in a dust-free environment or with a protective cover.

NOTE 1 The condition of the black cavity can be checked by reference to the instrument maker.

NOTE 2 The nominal value is given by the manufacturer.

6 Sampling

If the tests are being made to evaluate a lot, the sample shall be selected in accordance with ISO 186. If the tests are made on another type of sample, make sure that the test pieces taken are representative of the sample received.

7 Preparation of test pieces

Avoiding watermarks, dirt and obvious defects, cut rectangular test pieces approximately 75 mm × 150 mm. Assemble at least ten test pieces in a pad with their top sides uppermost; the number should be such that doubling the number of test pieces does not alter the reflectance factor. Protect the pad by placing an additional sheet of paper or board on both the top and bottom of the pad; avoid contamination and unnecessary exposure to light or heat.

Mark the top test piece in one corner to identify the sample and its top side, or to distinguish between the two sides.

If the top side can be distinguished from the wire side, it shall be uppermost; if not, as may be the case for papers manufactured on twin-wire machines, ensure that the same side of the sheet is uppermost.

8 Procedure

Remove the protecting sheets from the top and bottom of the test piece pad. Without touching the test area, use the working standard and the procedure appropriate to the instrument to obtain the three CIE tristimulus values of the first test piece (or CIELAB values if the instrument is designed to report directly in this colour space). Read and record the values to the nearest 0,05 unit. Move the uppermost test piece to the bottom of the pad and determine the values for succeeding test pieces until at least ten test pieces have been evaluated. If required, repeat the procedure for the other side of the test pieces.

9 Calculation

9.1 CIE tristimulus values

If the instrument has a bandpass of 5 nm or narrower, calculate the CIE tristimulus values in accordance with CIE Publication 15.2:1986. In all other cases, calculate the tristimulus values using the appropriate weighting functions given in ASTM E 308-95. If the instrument does not provide the CIE tristimulus values directly, obtain them by calculation using the tables provided in annex A.

9.2 CIELAB coordinates

Calculate the CIELAB coordinates from the tristimulus values X , Y , Z by means of the following equations:

$$L^* = 116 (Y/Y_n)^{1/3} - 16 \quad (1)$$