
**Paper and board — Determination of
colour by diffuse reflectance —**

**Part 1:
Indoor daylight conditions (C/2°)**

*Papier et carton — Détermination de la couleur par réflectance
diffuse —*

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Partie 1: Conditions d'éclairage intérieur de jour (C/2°)
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ISO 5631-1:2009

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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5631-1 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This first edition of ISO 5631-1 cancels and replaces ISO 5631:2000, which has been technically revised.

ISO 5631 consists of the following parts, under the general title *Paper and board — Determination of colour by diffuse reflectance*:

- *Part 1: Indoor daylight conditions (C/2°)* [ISO 5631-1:2009](https://standards.iteh.ai/catalog/standards/sist/8ea5f571-2583-4306-a89b-45208579d305/iso-5631-1-2009)
- *Part 2: Outdoor daylight conditions (D65/10°)*
- *Part 3: Indoor illumination conditions (D50/2°)*

Introduction

The colour of an object can be uniquely characterized by means of a triplet of colour coordinates such as the 1964 CIE tristimulus values or the CIELAB 1976 L^* , a^* , b^* coordinates.

Apart from the optical properties of the sample, the values of such coordinates depend upon the conditions of measurement, particularly the spectral and geometric characteristics of the instrument used. This part of ISO 5631 should therefore be read in conjunction with ISO 2469.

This part of ISO 5631 describes the measurement and description of colour in terms of the CIE illuminant C and the CIE 1931 (2°) standard observer. The other parts of this International Standard describe measurements and calculations carried out in an analogous manner using either the CIE standard illuminant D65 and the CIE 1964 (10°) standard observer or the CIE illuminant D50 and the CIE 1931 (2°) standard observer.

The choice of illuminant conditions is important when determining the colour coordinates of white papers containing a fluorescent whitening agent. In ISO 5631-2, the UV content of the illumination is much higher, approximating UV levels encountered in outdoor viewing conditions.

ISO 5631-3 describes the measurement and description of colour in terms of the CIE standard illuminant D50 and the CIE 1931 (2°) standard observer. This method is especially applicable to graphic arts situations since these illuminant/observer conditions are used within the graphic arts industry.

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Paper and board — Determination of colour by diffuse reflectance —

Part 1: Indoor daylight conditions (C/2°)

1 Scope

This part of ISO 5631 specifies a method for measuring the colour of paper and board by the diffuse reflectance method with the elimination of specular gloss.

This part of ISO 5631 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 ISO/TC 6 authorized laboratory, as described in ISO 2470-1.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 2469:2007, *Paper, board and pulps — Measurement of diffuse radiance factor*

ISO 2470-1, *Paper, board and pulps — Measurement of diffuse blue reflectance factor — Part 1: Indoor daylight conditions (ISO brightness)*

CIE Publication 15:2004, *Colorimetry*, 3rd ed.

ASTM E308-06, *Standard Practice for Computing the Colors of Objects by Using the CIE System*

3 Terms and definitions

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

3.1 radiance factor

β

ratio of the radiance of a surface element of a body in the direction delimited by a given cone, with its apex at the surface element, to that of the perfect reflecting diffuser under the same conditions of illumination

NOTE For fluorescent (luminescent) materials, the total radiance factor, β , is the sum of two portions, the reflected radiance factor, β_S , and the luminescent radiance factor, β_L , so that

$$\beta = \beta_S + \beta_L$$

For non-fluorescent materials, the reflected radiance factor, β_S , is numerically equal to the reflectance factor, R .

3.2 reflectance factor

R

ratio of the radiation reflected by a surface element of a body in the direction delimited by a given cone, with its apex at the surface element, to that of the perfect reflecting diffuser under the same conditions of illumination

NOTE 1 The ratio is often expressed as a percentage.

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

NOTE 3 The reflectance factor of a non-opaque sheet is dependent on the background and is not a material property.

3.3 intrinsic radiance [reflectance] factor

R_∞

radiance [reflectance] factor of a layer or pad of material thick enough to be opaque, such that increasing the thickness of the pad by doubling the number of sheets results in no change in the measured radiance [reflectance] factor

NOTE The ratio is often expressed as a percentage.

3.4 tristimulus values

X, Y, Z

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

NOTE 1 In this part of ISO 5631, the CIE 1931 (2°) standard observer and the CIE illuminant C are used to define the trichromatic system.

NOTE 2 No subscript is applied to conform to the CIE convention that tristimulus values have no subscript when the CIE 1931 (2°) standard observer is used [the subscript 10 is applied for tristimulus values that are obtained using the CIE 1964 (10°) standard observer].

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3.5

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

NOTE The quantity L^* is a measure of the lightness of the test piece, where $L^* = 0$ corresponds to black and $L^* = 100$ is defined by the perfect reflecting diffuser. Visually, the quantities a^* and b^* represent respectively the red-green and yellow-blue axes in colour space, such that

$+a^*$ is a measure of the degree of redness of the test piece,

$-a^*$ is a measure of the degree of greenness of the test piece,

$+b^*$ is a measure of the degree of yellowness of the test piece,

$-b^*$ is a measure of the degree of blueness of the test piece.

If both a^* and b^* are equal to zero, the test piece is grey.

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 for C/2° conditions.

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5 Apparatus

5.1 Reflectometer

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

If materials containing fluorescent whitening agents are to be measured, the reflectometer shall be equipped with a radiation source having an adequate UV content control adjusted to a UV condition corresponding to the C illuminant by the use of a reference standard, as described in ISO 2470-1.

5.1.2 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 a filter reflectometer, the radiation falling upon the test piece shall have a UV content corresponding to that of the CIE illuminant C.

5.1.3 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.

In the case of an abridged spectrophotometer, the instrument shall have an adjustable filter with a cut-off wavelength of 395 nm or some other equivalent system, and this filter shall be adjusted or the system shall be calibrated with the help of the fluorescent reference standard (5.2.2), so that the UV content of the illumination falling upon the sample corresponds to that of the CIE illuminant C.

5.2 Reference standards, for calibration of the instrument and the working standards and used frequently enough to ensure satisfactory calibration and UV adjustment.

5.2.1 Non-fluorescent reference standard, for photometric calibration, issued by an ISO/TC 6 authorized laboratory in accordance with the provisions of ISO 2469.