INTERNATIONAL STANDARD

ISO 5631-2

Second edition
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Paper and board — Determination of colour by diffuse reflectance —

Part 2: Outdoor daylight conditions (D65/10°)

Papier et carton — Détermination de la couleur par réflectance diffuse —
Partie 2: Conditions de lumière du jour extérieure (D65/10°)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 6, *Paper, board and pulps*.

This second edition cancels and replaces the first edition (ISO 5631-2:2008), of which it constitutes a minor revision.

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°)*

— *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 CIE X,Y,Z tristimulus values or the CIELAB 1976 L^*, a^*, b^* coordinates, for a specified CIE illuminant and CIE standard observer.

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 standard illuminant D65 and the CIE 1964 (10°) standard observer. The analogous measurement and description of colour in terms of the CIE illuminant C and the CIE 1931 (2°) standard observer are described in ISO 5631-1.

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 comparison of papers in graphic arts situations where the customer wishes to make measurements under these illuminant/observer conditions required by ISO 13655. The choice of illuminant conditions is important when determining the colour coordinates of white papers containing a fluorescent whitening agent. In ISO 5631-1, the UV content of the illumination is lower than those specified in this part of ISO 5631, approximating UV levels encountered in indoor rather than outdoor viewing conditions.

Paper and board — Determination of colour by diffuse reflectance —

Part 2: Outdoor daylight conditions (D65/10°)

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.

It can be used to determine the colour of papers or boards that contain fluorescent whitening agents, provided the UV content of the illumination on the test piece has been previously adjusted to give the calibrated colourimetric value corresponding to CIE standard illuminant D65, using a fluorescent reference standard with an assigned CIE whiteness (D65/10°) value provided by an authorized laboratory, as described in ISO 11475.

This part of ISO 5631 is not applicable to coloured papers or boards that incorporate fluorescent dyes or pigments.

2 Normative references

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

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

ISO 11475:2004, *Paper and board — Determination of CIE whiteness, D65/10° (outdoor daylight)*

ASTM E 308-06, *Standard Practice for Computing the Colors of Objects by Using the CIE System*

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

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 1 to entry: For fluorescent (luminescent) materials, the total radiance factor, β, is the sum of two portions, the reflected radiance factor, β_R, and the luminescent radiance factor, β_L, so that $\beta_T = \beta_R + \beta_L$.

Note 2 to entry: For non-fluorescent materials, the reflected radiance factor, β_R, is numerically equal to the reflectance factor, R.

3.2
intrinsic radiance factor
β_∞
radiance 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 factor

Note 1 to entry: The ratio is often expressed as a percentage.

3.3
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 to entry: The ratio is often expressed as a percentage.

Note 2 to entry: The reflectance factor is influenced by the backing if the body is translucent.

3.4
intrinsic reflectance factor
R_∞
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 reflectance factor

Note 1 to entry: The reflectance factor of a non-opaque sheet is dependent on the background and is not a material property.

3.5
tristimulus values
X_{10}, Y_{10}, Z_{10}
amount of the three reference colour stimuli, in a given chromatic system, required to match the stimulus considered

Note 1 to entry: In this part of ISO 5631, the CIE standard illuminant D65 and the CIE 1964 (10°) standard observer are used to define the trichromatic system.

Note 2 to entry: The subscript 10 is applied to conform to the CIE convention that tristimulus values have the subscript 10 when the CIE 1964 (10°) standard observer is used.

3.6
CIELAB colour space
three-dimensional, approximately uniform colour space, produced by plotting, in rectangular coordinates L^*, a^*, b^*, quantities defined by the formulae given in Clause 9

Note 1 to entry: 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, and

— $-b^*$ 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 colourimeter or by an abridged spectrophotometer, and the colour coordinates are then calculated for D65/10° conditions.

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.

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 D65 standard illuminant by the use of a reference standard, as described in ISO 11475.

5.1.2 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_{10}, Y_{10}, and Z_{10} of the CIE 1964 standard colourimetric system of the test piece evaluated for the CIE standard illuminant D65. 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 standard illuminant D65.

5.1.3 Abridged spectrophotometer, the instrument shall have a function that permits calculation of the CIE tristimulus values X_{10}, Y_{10}, and Z_{10}, of the CIE 1964 standard colourimetric system of the test piece evaluated for the CIE standard illuminant D65, 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 standard illuminant D65.

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

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

5.2.2 Fluorescent reference standard, for use in adjusting the UV content of the radiation incident upon the sample, having a CIE whiteness (D65/10°) value assigned by an authorized laboratory, as prescribed in ISO 11475:2004, Annex B.

5.3 Working standards, calibrated frequently enough to ensure that satisfactory calibration is maintained.

5.3.1 Two plates of flat opal glass, made of ceramic or other suitable material, cleaned, and calibrated as described in ISO 2469.

NOTE In some instruments, the function of the primary working standard can be taken over by a built-in internal standard.

5.3.2 Stable plastic or other tablet, incorporating a fluorescent whitening agent.

5.4 Black cavity, having a reflectance factor that 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.