



# SLOVENSKI STANDARD

## SIST ISO 11476:2011

01-maj-2011

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**Papir, karton in lepenka - Določanje beline po CIE, C/2° (pogoji osvetlitve v prostoru)**

Paper and board -- Determination of CIE whiteness, C/2 degrees (indoor illumination conditions)

**iTeh STANDARD PREVIEW**

Papier et carton -- Détermination du degré de blanc CIE C/2 degrés (éclairage intérieur)

**Ta slovenski standard je istoveten z: ISO 11476:2010**

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**ICS:**

85.060

Papir, karton in lepenka

Paper and board

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# INTERNATIONAL STANDARD

**ISO**  
**11476**

Second edition  
2010-08-01

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## Paper and board — Determination of CIE whiteness, C/2° (indoor illumination conditions)

*Papier et carton — Détermination du degré de blanc CIE C/2°  
(éclairage intérieur)*

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Reference number  
ISO 11476:2010(E)

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**ISO 11476:2010(E)****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 11476 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*. It is based on the CIE whiteness formula, published in CIE 15:2004, *Colorimetry*.

This second edition cancels and replaces the first edition (ISO 11476:2000), which has been technically revised to include the option to condition samples before measurements.

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# Paper and board — Determination of CIE whiteness, $C/2^\circ$ (indoor illumination conditions)

## 1 Scope

This International Standard specifies the procedure to be used for determining the CIE whiteness of papers and boards, in order to obtain values which correspond to the visual appearance of white papers and boards, with or without fluorescent whitening agents, when they are viewed indoors. It is based on radiance factor data obtained over the full visible spectral range (VIS) in contrast to the measurement of ISO brightness, which is limited to the blue region of VIS. This International Standard also specifies the procedures for the determination of CIE tint values and the fluorescent component of CIE whiteness.

In addition, it specifies a method for adjustment of the UV content to correspond to that of CIE illuminant C [10][11], since the results obtained when fluorescent whitening agents are present are dependent upon the UV content of the radiation falling upon the sample. The CIE illuminant C is taken to be representative of indoor illumination conditions because it contains a suitable proportion of UV radiation [12][13]. This method is not applicable to coloured papers containing fluorescent dyes. It is specific to the situation where the fluorescence occurs in the blue region of the visible spectral range.

This International Standard is read in conjunction with ISO 2469.

NOTE 1 It is recognized that the CIE whiteness equation was developed in the context of the CIE standard illuminant D65 [6], but the similarity between the relative spectral power curves for the C and D65 illuminants within the visible region and the closeness of their correlated colour temperatures (6 770 K and 6 500 K respectively) are taken as a justification for the use of the analogous whiteness equation with the CIE illuminant C.

NOTE 2 A related International Standard, ISO 11475 [4] specifies the procedure for obtaining values corresponding to the appearance of papers viewed under the CIE standard illuminant D65.

## 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, *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)*

## ISO 11476:2010(E)

### 3 Terms and definitions

For the purposes of this document, 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

NOTE The reflectance factor is usually expressed as a percentage.

#### 3.2 intrinsic reflectance factor reflectivity

$R_{\infty}$

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

#### 3.3 radiance factor

$\beta$

ratio of the radiance of a body to that of the perfect reflecting diffuser under the same conditions of illumination and viewing

NOTE For fluorescent (luminescent) materials, the total radiance factor,  $\beta$ , is the sum of two portions, the reflected radiance factor,  $\beta_S$ , and the luminescent radiance factor,  $\beta_L$ , so that

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

For non-fluorescent materials, the reflected radiance factor,  $\beta_S$ , is simply the reflectance factor,  $R$ .

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#### 3.4 intrinsic radiance factor

$\beta_{\infty}$

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

NOTE For fluorescent (luminescent) materials, the intrinsic total radiance factor,  $\beta_{\infty}$ , is the sum of two portions, the intrinsic reflected radiance factor,  $\beta_{\infty,S}$ , and the intrinsic luminescent radiance factor,  $\beta_{\infty,L}$ , so that

$$\beta_{\infty} = \beta_{\infty,S} + \beta_{\infty,L}$$

For non-fluorescent materials, the intrinsic reflected radiance factor,  $\beta_{\infty,S}$ , is simply the intrinsic reflectance factor,  $R_{\infty}$ .

#### 3.5 CIE whiteness

$W$

measure of CIE whiteness derived from the CIE tristimulus values determined under the conditions specified in this International Standard

NOTE The CIE whiteness is expressed in CIE whiteness units.

#### 3.6 green/red tint

$T_w$

measure of the deviation from CIE whiteness of the test material towards the green or red region

NOTE 1 The deviation is expressed as CIE tint units.

NOTE 2 A positive value of  $T_w$  indicates a greenish tint and a negative value indicates a reddish tint.



**3.7****fluorescence component** $W_F$ 

measure of the extent to which the CIE whiteness of the material is affected by excitation of the added fluorescent whitening agent (FWA) under the conditions specified in this International Standard

**4 Principle**

The diffuse radiance factor of the material is determined under standardized conditions after adjustment of the instrument so that the relative UV content of the illumination corresponds to that of the CIE illuminant C, and the CIE whiteness and tint are calculated. The fluorescence component of the CIE whiteness is calculated from the difference between the diffuse radiance factor value and the value obtained when the fluorescence emission from the material is eliminated, for instance by the introduction into the light beams of a sharp-cut-off UV-absorbing filter.

**5 Apparatus and equipment**

**5.1 Reflectometer or spectrophotometer**, having the geometric, spectral and photometric characteristics described in ISO 2469, calibrated in accordance with the provisions of ISO 2470-1, and equipped with a radiation source having an adequate UV content and a means of adjusting the relative UV content so that the measured ISO brightness value agrees with the ISO brightness value assigned to a fluorescent reference standard (5.2.2) and corresponding to the CIE illuminant C (References [7], [8] and [11] in the Bibliography). If a filter (the UV-adjustment filter) is used to make this adjustment, it shall have a cut-off value of 395 nm so that it absorbs UV radiation but does not, at the same time, alter the visible spectrum within the sphere.

NOTE In order to achieve concordance between the conditions for measuring both ISO brightness and CIE whiteness ( $C/2^\circ$ ), an adjustment based on a fluorescent reference standard (5.2.2) having an assigned ISO brightness value is preferred.

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For the measurement of reflectance factors with the fluorescence effect eliminated, the instrument shall be equipped with a sharp-cut-off, UV-absorbing filter (the UV cut-off filter) having a transmittance not exceeding 5,0 % at and below a wavelength of 410 nm and not exceeding 50 % at a wavelength of 420 nm. The cut-off filter shall have characteristics such that a repeatable reflectance factor value is obtained at 420 nm. The reflectance factor value obtained at 420 nm shall then be considered for computational purposes to be the value which applies at all lower wavelengths, at which it is not possible to make any measurement.

For the measurement of fluorescent papers, photometric linearity up to a scale reading of at least 200 % is necessary in the wavelength region corresponding to the fluorescent emission.

**5.1.1** In the case of a filter reflectometer, pairs of filters giving the photoelectric detectors of the reflectometer responses equivalent to the CIE tristimulus values  $X$ ,  $Y$ ,  $Z$  of the test piece (Reference [7] in the Bibliography), evaluated for the CIE illuminant C (Reference [8] in the Bibliography) and CIE 1931 ( $2^\circ$ ) observer (Reference [5] in the Bibliography).

**5.1.2** In the case of an abridged spectrophotometer, a means of calculating the weighted means in accordance with the requirements of the CIE illuminant C and CIE 1931 ( $2^\circ$ ) observer using the weighting functions given in Annex A.

**5.2 Reference standards for calibration of the instrument and working standards**

**5.2.1** Non-fluorescent reference standard for calibration, fulfilling the requirements for ISO reference standards of level 3, as specified in ISO 2470-1.

**5.2.2** Fluorescent reference standard for use in adjusting the UV content of the radiation incident upon the sample, having an assigned ISO brightness value, as specified in Annex B, and fulfilling the requirements for ISO reference standards of level 3, as specified in ISO 2470-1.

Use new reference standards sufficiently frequently to ensure satisfactory calibration and UV adjustment.