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Colorimetry — **Part 2:** **CIE standard illuminants**

Colorimétrie —

Partie 2: Illuminants CIE normalisés



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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.

ISO 11664-2 was prepared as Standard CIE S 014-2/E by the International Commission on Illumination, which has been recognized by the ISO Council as an international standardizing body. It was adopted by ISO under a special procedure which requires approval by at least 75 % of the member bodies casting a vote, and is published as a joint ISO/CIE edition.

The International Commission on Illumination (abbreviated as CIE from its French title) is an organization devoted to international cooperation and exchange of information among its member countries on all matters relating to the science and art of lighting.

International Standard ISO 11664-2 was prepared by CIE Technical Committee 2-33 *Reformulation of CIE Standard Illuminants A and D65*.

ISO 11664-2 was initially published by ISO as ISO 10526:2007, and has subsequently been renumbered to be part 2 of the ISO 11664 series.

ISO 11664 consists of the following parts, under the general title *Colorimetry*:

- *Part 1: CIE standard colorimetric observers* [published previously as ISO 10527:2007, which has been cancelled]
- *Part 2: CIE standard illuminants* [published previously as ISO 10526:2007, which has been cancelled]
- *Part 4: CIE 1976 L*a*b* Colour space*

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Standard

COMMISSION INTERNATIONALE DE L'ÉCLAIRAGE
INTERNATIONAL COMMISSION ON ILLUMINATION
INTERNATIONALE BELEUCHTUNGSKOMMISSION

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Colorimetry - Part 2: CIE Standard Illuminants

Colorimétrie - Partie 2: Illuminants normalisés CIE

Farbmessung - Teil 2: CIE Normlichtarten

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Descriptor: Standardisation of colour measurement
Standard colorimetric system

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FOREWORD

Standards produced by the Commission Internationale de l'Eclairage (CIE) are a concise documentation of data defining aspects of light and lighting, for which international harmony requires such unique definition. CIE Standards are therefore a primary source of internationally accepted and agreed data, which can be taken, essentially unaltered, into universal standard systems.

This CIE Standard replaces ISO 10526:1999/CIE S005:1998 and was approved by the CIE Board of Administration and the National Committees of the CIE. It contains only minor changes from the previous standard, which was prepared by CIE Technical Committee 2-33, "Reformulation of CIE Standard Illuminants A and D65" *).

The numerical values of the relative spectral distributions of standard illuminants A and D65 defined by this Standard are the same, within an accuracy of six significant digits, as those defined in earlier versions of these illuminants.

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This present revision was finalized by an editorial group in CIE Division 2: J. Gardner (AU), T. Goodman (UK), K. Mielenz (US), J. Moore (UK), Y. Ohno (US), A. Robertson (CA), J. Schanda (HU).

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COLORIMETRY - PART 2: CIE STANDARD ILLUMINANTS

1. SCOPE

This International Standard specifies two illuminants for use in colorimetry. The illuminants, which are defined in clauses 4 and 5 of this International Standard, are as follows:

a) CIE standard illuminant A

This is intended to represent typical, domestic, tungsten-filament lighting. Its relative spectral power distribution is that of a Planckian radiator at a temperature of approximately 2 856 K. CIE standard illuminant A should be used in all applications of colorimetry involving the use of incandescent lighting, unless there are specific reasons for using a different illuminant.

b) CIE standard illuminant D65

This is intended to represent average daylight and has a correlated colour temperature of approximately 6 500 K. CIE standard illuminant D65 should be used in all colorimetric calculations requiring representative daylight, unless there are specific reasons for using a different illuminant. Variations in the relative spectral power distribution of daylight are known to occur, particularly in the ultraviolet spectral region, as a function of season, time of day, and geographic location. However, CIE standard illuminant D65 should be used pending the availability of additional information on these variations.

Values for the relative spectral power distribution of CIE standard illuminants A and D65 are given in Table 1 of this International Standard. Values are given at 1 nm intervals from 300 nm to 830 nm.

The term "illuminant" refers to a defined spectral power distribution, not necessarily realizable or provided by an artificial source. Illuminants are used in colorimetry to compute the tristimulus values of reflected or transmitted object colours under specified conditions of illumination. The CIE has also defined illuminant C and other illuminants D. These illuminants are described in Publication CIE 15:2004 but they do not have the status of primary CIE standards accorded to the CIE standard illuminants A and D65 described in this International Standard. It is recommended that one of the two CIE standard illuminants defined in this International Standard be used wherever possible. This will greatly facilitate the comparison of published results.

It is noted that in the fields of graphic arts and photography extensive use is also made of CIE illuminant D50.

In most practical applications of colorimetry, it is sufficient to use the values of CIE standard illuminants A and D65 at less frequent wavelength intervals or in a narrower spectral region than defined in this Standard. Data and guidelines that facilitate such practice are provided in Publication CIE 15:2004, together with other recommended procedures for practical colorimetry.

The term "source" refers to a physical emitter of light, such as a lamp or the sky. In certain cases, the CIE recommends laboratory sources that approximate the spectral power distributions of CIE illuminants. In all cases, however, the definition of a CIE recommended source is secondary to the definition of the corresponding CIE illuminant, because of the possibility that, from time to time, new developments will lead to improved sources that represent a particular illuminant more accurately or are more suitable for laboratory use.

Subclause 6.1 of this International Standard describes CIE source A, which is recommended for laboratory realizations of CIE standard illuminant A. At present, there is no CIE recommended source representing 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.

CIE 15:2004. *Colorimetry*, 3rd edition.

CIE 17.4-1987. *International Lighting Vocabulary* (ILV) - Joint publication IEC/CIE.

ISO 23603:2005/CIE S 012/E:2004. *Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour*.

CIE S 014-1/E:2006. *Colorimetry Part 1: CIE standard colorimetric observers*. [ISO 11664-1:2007]

3. DEFINITIONS

For the purposes of this International Standard, the following definitions apply. These definitions are taken from CIE 17.4-1987, where other relevant terms will also be found.

3.1 chromaticity coordinates (see ILV 845-03-33)

ratio of each of a set of three tristimulus values to their sum

NOTE 1: As the sum of the three chromaticity coordinates equals 1, two of them are sufficient to define a chromaticity.

NOTE 2: In the CIE 1931 and 1964 standard colorimetric systems, the chromaticity coordinates are represented by the symbols x , y , z and x_{10} , y_{10} , z_{10} .

3.2 chromaticity diagram (see ILV 845-03-35)

plane diagram in which points specified by chromaticity co-ordinates represent the chromaticities of colour stimuli

3.3 CIE standard illuminants

illuminants A and D65 defined by the CIE in terms of relative spectral power distributions¹

3.4 CIE sources

artificial sources, specified by the CIE, whose relative spectral power distributions are approximately the same as those of CIE standard illuminants¹

3.5 CIE 1976 uniform chromaticity scale diagram; CIE 1976 UCS diagram (see ILV 845-03-53)

uniform chromaticity scale diagram produced by plotting in rectangular co-ordinates v' against u' , quantities defined by the equations

$$u' = 4X/(X + 15Y + 3Z) = 4x/(-2x + 12y + 3)$$

$$v' = 9Y/(X + 15Y + 3Z) = 9y/(-2x + 12y + 3)$$

X , Y , Z are the tristimulus values in the CIE 1931 or 1964 standard colorimetric systems, and x , y are the corresponding chromaticity coordinates of the colour stimulus considered.

3.6 colour temperature T_c (see ILV 845-03-49)

temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus

¹ This definition is a revision of the definition given in CIE 17.4-1987.