

# INTERNATIONAL STANDARD

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## Colorimetry —

Part 4:

### **CIE 1976 L\*a\*b\* Colour space**

*Colorimétrie —*

*Partie 4: Espace chromatique L\*a\*b\* CIE 1976*



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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 11664-4 was prepared as Standard CIE S 014-4/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.

ISO 11664-4 was prepared by CIE Technical Committee 1-57 of Division 1, *Vision and colour*.

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

- Part 1: CIE standard colorimetric observers
- Part 2: CIE standard illuminants
- 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

CIE S 014-4/E:2007

# Colorimetry - Part 4: CIE 1976 $L^*a^*b^*$ Colour Space

Colorimétrie - Partie 4: Espace chromatique  $L^*a^*b^*$  CIE 1976

Farbmessung - Teil 4: CIE 1976  $L^*a^*b^*$  Farbenraum

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Standard colorimetric systems

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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 has been prepared by the Technical Committee TC 1-57\* of Division 1 "Vision and Colour" and was approved by the National Committees of the CIE.

The following ISO and IEC committees and working groups co-operated in the preparation of this standard:

IEC TC100/TA2 (Audio, Video and Multimedia Systems)

ISO TC6 (Paper, Board and Pulps)

ISO TC35/SC9/WG22 (Paint and Varnishes)

ISO TC38/SC1/WG7 (Textiles)

ISO TC42 (Photography)

ISO TC130 (Graphic Technology)

ISO/IEC/JTC1/SC28 (Office Systems)

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\* The chairperson of this TC was A.R. Robertson (CA), members were: P.J. Alessi (US), J.A. Bristow (SE), J. Campos Acosta (ES), R. Connelly (US), J.-F. Decarreau (FR), R. Harold (US), R. Hirschler (HU), H. Ikeda (JP), B. Jordan (CA), C. Kim (KR), D. McDowell (US), P. McGinley (AU), Y. Ohno (US), M.R. Pointer (GB), K. Richter (DE), G. Rösler (DE), J.D. Schanda (HU), R. Sève (FR), K. Smith (GB), K. Witt (DE), H. Yaguchi (JP), J. Zwinkels (CA).

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## COLORIMETRY - PART 4: CIE 1976 L\*a\*b\* COLOUR SPACE

### INTRODUCTION

The three-dimensional colour space produced by plotting CIE tristimulus values ( $X, Y, Z$ ) in rectangular coordinates is not visually uniform, nor is the ( $x, y, Y$ ) space nor the two-dimensional CIE ( $x, y$ ) chromaticity diagram. Equal distances in these spaces do not represent equally perceptible differences between colour stimuli. For this reason, in 1976, the CIE introduced and recommended two new spaces (known as CIELAB and CIELUV) whose coordinates are non-linear functions of  $X$ ,  $Y$  and  $Z$ . The recommendation was put forward in an attempt to unify the then very diverse practice in uniform colour spaces and associated colour difference formulae (Robertson, 1990; CIE, 2004). Both these more-nearly uniform colour spaces have become well accepted and widely used. Numerical values representing approximately the magnitude of colour differences can be described by simple Euclidean distances in the spaces or by more sophisticated formulae that improve the correlation with the perceived size of differences. The purpose of this CIE Standard is to define procedures for calculating the coordinates of the CIE 1976 L\*a\*b\* (CIELAB) colour space and the Euclidean colour difference values based on these coordinates. The standard does not cover more sophisticated colour difference formulae based on CIELAB, such as the CMC formula (Clarke et al., 1984), the CIE94 formula (CIE, 1995), the DIN99 formula (DIN, 2001), and the CIEDE2000 formula (CIE, 2001), nor does it cover the alternative uniform colour space, CIELUV.

### 1. SCOPE

This CIE Standard specifies the method of calculating the coordinates of the CIE 1976 L\*a\*b\* colour space including correlates of lightness, chroma and hue. It includes two methods for calculating Euclidean distances in this space to represent the perceived magnitude of colour differences.

The Standard is applicable to tristimulus values calculated using colour-matching functions of the CIE 1931 standard colorimetric system or the CIE 1964 standard colorimetric system. The Standard may be used for the specification of colour stimuli perceived as belonging to a reflecting or transmitting object, where a three-dimensional space more uniform than tristimulus space is required. It does not apply to colour stimuli perceived as belonging to an area that appears to be emitting light as a primary light source, or that appears to be specularly reflecting such light. This Standard does apply to self-luminous displays, like cathode ray tubes, if they are being used to simulate reflecting or transmitting objects and if the stimuli are appropriately normalized.

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

CIE S 014-1:2006. *Colorimetry Part 1. CIE Standard Colorimetric Observers*. [ISO 11664-1:2007]

CIE S 014-2:2006. *Colorimetry Part 2. CIE Standard Illuminants*. [ISO 11664-2:2007]

### 3. DEFINITIONS, SYMBOLS AND ABBREVIATIONS

For the purposes of this International Standard, the terms and definitions given in CIE 17.4-1987 (International Lighting Vocabulary), as amended by this standard and the following symbols and abbreviations apply.

$X, Y, Z$	tristimulus values of test stimulus calculated using the colour-matching functions of the CIE 1931 standard colorimetric system (also known as the CIE 2° standard colorimetric system)
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