



SLOVENSKI STANDARD
SIST EN 61966-7-1:2003
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Multimedia systems and equipment - Colour measurement and management - Part 7-1: Colour printers - Reflective prints - RGB inputs (IEC 61966-7-1:2001)

Multimedia systems and equipment - Colour measurement and management -- Part 7-1: Colour printers - Reflective prints - RGB inputs

Multimediasysteme und -geräte - Farbmessung und Farbmanagement -- Teil 7-1: Farbdrucker - Reflektierende Drucke - RGB-Eingänge

Systèmes et appareils multimédia - Mesure et gestion de la couleur -- Partie 7-1: Imprimantes couleur - Imprimés par réflexion - Entrées RVB

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| 17.180.20 | Barve in merjenje svetlobe | Colours and measurement of light |
| 33.160.60 | Multimedia systems and teleconferencing equipment | |

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EUROPEAN STANDARD

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**Multimedia systems and equipment -
Colour measurement and management
Part 7-1: Colour printers -
Reflective prints - RGB inputs
(IEC 61966-7-1:2001)**

Systèmes et appareils multimédia -
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(CEI 61966-7-1:2001)

Multimediasysteme und -geräte -
Farbmessung und Farbmanagement
Teil 7-1: Farbdrucker -
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(IEC 61966-7-1:2001)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 100/238/FDIS, future edition 1 of IEC 61966-7-1, prepared by IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61966-7-1 on 2001-09-01.

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- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2002-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-09-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, B, C and ZA are normative and annexes D, E and F are informative.

Annex ZA has been added by CENELEC.

EN 61966 consists of the following parts, under the general title: Multimedia systems and equipment - Colour measurement and management:

- Part 1: General
- Part 2-0: Colour management in multimedia systems
- Part 2-1: Colour management - Default RGB colour space - sRGB
- Part 2-2: Colour management - Extended RGB colour space - sRGB64
- Part 2-3: Colour management - Default YCC colour space - sYCC
- Part 3: Equipment using cathode ray tubes
- Part 4: Equipment using liquid crystal display panels
- Part 5: Equipment using plasma display panels
- Part 6: Equipment used for digital image projection
- Part 7-1: Colour printers - Reflective prints - RGB inputs
- Part 7-2: Colour printers - Reflective prints - CMYK inputs
- Part 7-3: Colour printers - Transparent prints
- Part 8: Multimedia colour scanners
- Part 9: Digital cameras
- Part 10: Quality assessment - Colour image in network systems
- Part 11: Quality assessment - Impaired video in network systems

Endorsement notice

The text of the International Standard IEC 61966-7-1:2001 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

This part of IEC 61966 is applicable to characterization of colour printers that produce colour images on opaque substrate corresponding to digital data files in which colour image information is expressed in a red – green – blue colour space. The characterization will be realized by objective measurements to be utilized for colour management in open systems. The measured and reported results are used to relate the equipment-dependent and undefined red – green – blue colour space to the default RGB colour space defined as the sRGB by IEC 61966-2-1. This standard is also applicable to assessment of colour image attributes on reflective prints reproduced from colour digital image files.

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MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

Part 7-1: Colour printers – Reflective prints – RGB inputs

1 Scope

This part of IEC 61966 specifies a set of data in colour digital image files for measurements, sampling of successive prints, measurement conditions and forms of reporting the results so as to make possible the characterization of the colour printer and comparison of the results of measurements. The sets of data for measurements are in colour digital image files expressed in a red – green – blue colour space, to which corresponding colour images are reproduced on reflective substrate. The methods of measurement in this standard are designed to be applicable to reflective colour prints for consumer use. The reflective colour prints may be produced by non-impact colour printers, incorporating such technologies as ink-jet, sublimation transfer, thermal transfer, electro-photography and other similar technologies.

This standard does not specify limiting values for various attributes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61966. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61966 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(845):1987, *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting / CIE 17.4: 1987, International Lighting Vocabulary* (joint IEC/CIE publication)

IEC 61966-2-1:1999, *Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB*

ISO/CIE 10526: 1999, *CIE standard illuminants for colorimetry*

ISO/CIE 10527:1991, *CIE standard colorimetric observers*

CIE 15.2:1986, *Colorimetry*

ISO 216:1975, *Writing paper and certain classes of printed matter – Trimmed sizes – A and B series*

3 Terms and definitions

For the purpose of this part of IEC 61966, terms which relate to lighting in IEC 60050(845)/CIE 17.4 and the following definitions apply.

3.1 colour printer

system composed of application program to handle colour digital image files, driver for equipment that produces colour images on a substrate, and the equipment itself which accepts equipment specific data for each input channel and is able to process by such technologies as ink jet, sublimation transfer, thermal transfer, or electro-photography and other similar technologies

NOTE The colour printer includes a system whereby the equipment that reproduces prints is directly connected to another piece of equipment in which a set of colour digital image data is contained.

3.2 driver

software code which converts output data from an application program to feed a series of digital signals to the equipment which produces reflective prints

3.3 application program

any software which has access to the colour digital image file and output colour image information to the driver, and possibly renders the colour image on displays

3.4 consumable

any material necessary to run colour printers; for example, sheets of paper, toners, ink, fuser oil, etc.

3.5 half-tone screen

set of rules for two dimensional pixel layouts to render a tone

3.6 image

visible two-dimensional representation of electronic signals intended to form a picture

3.7 substrate

opaque substance providing support for a medium

3.8 reflective print

colour image reproduced on a piece of substrate

3.9 gamut of colours

three-dimensional maximum range of reproducible colours expressed in CIE 1976 $L^*a^*b^*$ colour space defined in CIE 15.2

3.10 primary colours

colours used to define a colour space incorporated in the colour digital image file

NOTE Red, green and blue are the primary colours for this standard.

3.11 secondary colours

colours to be defined by a mixture of two primary colours except black

NOTE Cyan, magenta and yellow are the secondary colours for this standard.

3.12**saturated colours**

primary colours and secondary colours intended to be reproduced corresponding to their maximum excitation of electronic signals

NOTE Saturation means the maximum excitation purity (chromaticity), limited by each specific system.

3.13**reproduced colours**

colorimetric information measured from the reflective print, expressed in the CIE 1976 colour space defined in CIE 15.2

3.14**tone reproduction**

relationship between data in the colour digital image file which are intended to reproduce the images of primary, secondary and achromatic colours and the CIE 1976 lightness values of reflective prints actually reproduced

3.15**characterization**

process of obtaining the spectral characteristics, basic colorimetric characteristics, tone reproduction characteristics, spatial non-uniformity characteristics, temporal instability characteristics or dependency on illuminant characteristics. In general, these characteristics relate the input RGB signal to some measured CIE colour values

3.16**electronic signal**

data prepared as a colour digital image file intended to form a picture

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4 Letters and symbols

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The letters and symbols consistently adopted in this part of IEC 61966 are summarized below.

N_s	The number of samples of reflective prints for measurements
N_u	Metric in colour difference ΔE_{ab}^* for spatial non-uniformity within a page
N_t	Metric in colour difference ΔE_{ab}^* for short-term instability among successive reflective prints
P	Printing speed of the colour printer
$S(\lambda)$	Spectral power distribution of the illuminant D50
$\rho(\lambda)$	Spectral reflectance of a printed image
D_R, D_G, D_B	Digital data in integers fed to colour printers
R, G, B	Data normalized by $2^N - 1$, where N is the number of bits per channel
$\tilde{L}^*, \tilde{a}^*, \tilde{b}^*$	Colour in CIE 1976 UCS in reference to printed colour white, see also equation (4)

5 Conditions

5.1 Environmental conditions

Sampling and measurements shall be carried out within the environmental conditions specified by the manufacturer of the equipment that produces reflective prints, unless otherwise specified by this standard. The environmental conditions, at least the room temperature and the relative humidity, during sampling and measurement, shall be reported together with the presentation of the results of measurements.

NOTE Recommended environmental conditions are a temperature of $20\text{ °C} \pm 5\text{ °C}$, a relative humidity of $65\% \pm 10\%$ and atmospheric pressure from 86 kPa to 106 kPa, unless otherwise specified.

5.2 Sampling conditions

5.2.1 Substrate

The substrate shall be opaque as specified by the manufacturer of the equipment that produces reflective prints as either recommended or default. The substrate shall be exposed for at least one day in order to be accustomed to the environmental conditions.

5.2.2 Settings and operation

5.2.2.1 Half-tone screen

All sampling shall be carried out in the half-tone screen mode whenever applicable. This shall be as specified by the manufacturer of the equipment that produces reflective prints as either recommended or default. When multiple options such as half-tone screen for texts, graphics, and natural pictures are available, the choices shall be reported together with the presentation of the results of measurements.

If the half-tone screen is not applicable, this shall be reported together with the presentation of the results.

5.2.2.2 Resolution

All sampling shall be carried out with the resolution setting specified by the manufacturer of the equipment that produces reflective prints as either recommended or default. When multiple options such as resolution for texts, graphics, natural pictures are available, the choices shall be reported together with the presentation of the results of measurements.

5.2.2.3 Miscellaneous settings

Colour rendering, digital filtering and tone reproduction characteristics shall be set as specified by the manufacturer of the printing equipment that produces reflective prints as either recommended or default.

The application programme used should provide no extra colour processing or enhancement. Otherwise, a type of colour processing or enhancement shall be reported.

5.2.3 Number of samples

To minimize an error due to short-term variation and non-uniformity within a page, the number of samples of reflective prints N_s should be decided by equation (1), except for clause 9, and subclauses 10.1 and 10.2.

$$N_s = \sqrt{N_u^2 + N_t^2} \quad (1)$$

where N_u is the metric in colour difference ΔE_{ab}^* for spatial non-uniformity within a page as defined in equation (7) and N_t is the metric in colour difference ΔE_{ab}^* for short-term instability among successive reflective prints as defined in equation (8).

The number of samples less than N_s shall be reported together with the presentation of the results of measurements.

NOTE For simplicity of the characterization procedure, $N_s = 1$ may be allowed.

5.2.4 Operation of colour printers

All sampling shall be carried out in line with the conditions specified in the operation manuals of the colour printer, unless otherwise specified in this standard.

5.2.5 Electric power source

All sampling shall be carried out with an a.c. power source with nominal voltage $\pm 10\%$ of stable frequency.

5.2.6 Consumables

All sampling shall be carried out with the consumables for the equipment that produces reflective prints as specified by the manufacturer of the equipment.

5.2.7 Other conditions (standards.iteh.ai)

All sampling shall be carried out after the warm-up time specified by the manufacturer of the equipment that produces reflective prints, unless otherwise specified in this standard.

NOTE If the equipment that produces reflective prints has multiple paper trays, any paper tray can be used for sampling.

5.3 Measurement conditions

5.3.1 General

To minimize an error due to instability of the instruments for colorimetric measurement, the reflective prints shall be measured at least three times and the measured data shall be averaged. The number of average times less than three shall be reported together with the presentation of the results of measurements.

5.3.2 Spectrophotometric and colorimetric measurements

Reflective prints shall be measured successively without any time interval, unless otherwise specified.

For spectrophotometric measurement, spectral reflectance of the reflective prints shall be measured over the wavelengths at least from 400 nm to 700 nm every 10 nm for the reflective print illuminated by incandescent lamps and every 5 nm for the reflective print illuminated by fluorescent lamps.

NOTE 1 The measurement over the wavelengths from 380 nm to 780 nm is recommended.

NOTE 2 The spectral reflectance should be measured using a spectrophotometer with either 0°/45° or 45°/0° geometry as specified in ISO 5-4, in order to remove specular component of the reflected light.

For colorimetric measurement, the spectral radiance of the illumination shall be approximated to the illuminant D50 defined in table 1.1 of CIE 15.2.

The name of the manufacturer of the measuring instrument, the model number and the manufactured date shall be reported together with the measured results.

5.3.3 Backing material

White backing material, such as five pieces or more of the same substrate, on which the colour image is printed, shall be used. When other backing materials are used, the specification of the material shall be reported together with the presentation of the results of measurements.

NOTE For estimation of the effect of backing material changes, refer to annex E.

5.4 Method of calculation

5.4.1 Illuminants and colorimetric observers

The illuminant D50 defined in table 1.1 of CIE 15.2 and the CIE 1931 Standard Colorimetric Observer defined in ISO/CIE 10527 shall be used for calculation of the tristimulus values from the measured spectral data. If any other illuminants are used, it shall be reported.

NOTE For some measurements, optical reflective density may be used, but it should be noted that the measured values depend on the instruments used for the measurement.

5.4.2 Tristimulus values

The tristimulus values X , Y and Z in the CIE 1931 XYZ colour space for object colours and illuminant colours shall be calculated by the summations of the products of the spectral power distribution $S(\lambda)$ of the illuminant D50, the spectral reflectance $\rho(\lambda)$ of the printed image, and the colour matching functions $\bar{x}(\lambda)$, $\bar{y}(\lambda)$, $\bar{z}(\lambda)$, in accordance with equation (2);

$$\begin{aligned} X &= \frac{1}{K} \int_{\text{vis}} S(\lambda) \rho(\lambda) \bar{x}(\lambda) d\lambda \\ Y &= \frac{1}{K} \int_{\text{vis}} S(\lambda) \rho(\lambda) \bar{y}(\lambda) d\lambda \\ Z &= \frac{1}{K} \int_{\text{vis}} S(\lambda) \rho(\lambda) \bar{z}(\lambda) d\lambda \end{aligned} \quad (2)$$

where $K = \int_{\text{vis}} S(\lambda) \bar{y}(\lambda) d\lambda$.

5.4.3 CIELAB colour space

The CIELAB values L^* , a^* and b^* in the CIE 1976 $L^*a^*b^*$ colour space shall be calculated as in equation (3) in accordance with CIE 15.2.

$$\begin{aligned} L^* &= 116 \left(\frac{Y}{Y_n} \right)^{\frac{1}{3}} - 16 \\ a^* &= 500 \left\{ \left(\frac{X}{X_n} \right)^{\frac{1}{3}} - \left(\frac{Y}{Y_n} \right)^{\frac{1}{3}} \right\} \\ b^* &= 200 \left\{ \left(\frac{Y}{Y_n} \right)^{\frac{1}{3}} - \left(\frac{Z}{Z_n} \right)^{\frac{1}{3}} \right\} \end{aligned} \quad (3)$$