INTERNATIONAL STANDARD

IEC 61966-7-1

First edition
2001-05

Multimedia systems and equipment – Colour measurement and management –

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

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CONTENTS

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MULTIMEDIA SYSTEMS AND EQUIPMENT –
COLOUR MEASUREMENT AND MANAGEMENT –

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

FOREWORD

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International Standard IEC 61966-7-1 has been prepared by TC 100/TA 2: Colour measurement and management, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/238/FDIS	100/248/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B and C form an integral part of this standard.

Annexes D, E and F are for information only.

IEC 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

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

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.

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

4 Letters and symbols

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 °C ± 5 °C, a relative humidity of 65 % ± 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.

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

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 ±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

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);

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

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.

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

where the tristimulus values X_n, Y_n and Z_n correspond to the illuminant D50; $X_n = 96{,}42$, $Y_n = 100{,}00$ and $Z_n = 82{,}49$.

Relative values to the colour white shall also be calculated when it is required in accordance with equation (4).

$$\begin{aligned} \tilde{L}^* &= 116\left(\frac{Y}{Y_W}\right)^{\frac{1}{3}} - 16 \\ \tilde{a}^* &= 500\left\{\left(\frac{X}{X_W}\right)^{\frac{1}{3}} - \left(\frac{Y}{Y_W}\right)^{\frac{1}{3}}\right\} \\ \tilde{b}^* &= 200\left\{\left(\frac{Y}{Y_W}\right)^{\frac{1}{3}} - \left(\frac{Z}{Z_W}\right)^{\frac{1}{3}}\right\} \end{aligned} \qquad (4)$$

where the tristimulus values X_W, Y_W and Z_W correspond to the printed colour white resulting from $D_R = D_G = D_B = 2^N - 1$ under the illuminant D50.

5.4.4 Averaging CIELAB values

The colorimetric values in the CIELAB colour space for reproduced colour chips obtained by multiple printing jobs shall be averaged over all the measured and calculated values as in equation (5),

$$\begin{aligned} \overline{L}^* &= \frac{1}{N_s}\sum_{n=1}^{N_s} L_n^* \\ \overline{a}^* &= \frac{1}{N_s}\sum_{n=1}^{N_s} a_n^* \\ \overline{b}^* &= \frac{1}{N_s}\sum_{n=1}^{N_s} b_n^* \end{aligned} \qquad (5)$$

for clauses 6, 7 and 8, where N_s is the number of printing jobs defined in equation (1); and

$$\begin{aligned} \overline{L}^* &= \frac{1}{M}\sum_{m=1}^{M} L_m^* \\ \overline{a}^* &= \frac{1}{M}\sum_{m=1}^{M} a_m^* \\ \overline{b}^* &= \frac{1}{M}\sum_{m=1}^{M} b_m^* \end{aligned} \qquad (6)$$

for 10.1, where M is the number of printing jobs defined in 10.1.2. For simplicity, $\overline{L}^*$, $\overline{a}^*$ and $\overline{b}^*$ are written without the bars in the following clauses.

6 Spectral characteristics

6.1 Attributes to be measured

Spectral reflectance of reflective prints for primary colours, secondary colours, black and white.

6.2 Method of measurement

The colour digital image file containing data for red – green – blue as the primary colours, cyan – magenta – yellow as the secondary colours, and black, grey and white shall be prepared. The names of the colours and the identification numbers in table A.1 (a) are shown in table 1 below.

Table 1 – Reference to table A.1 (a)

Colour	Identification number	Colour	Identification number
Red	1	Yellow	6
Green	2	Black	7
Blue	3	Grey	8
Cyan	4	White	9
Magenta	5		

NOTE Actual data in a red – green – blue colour space in table A.1 (a) provide examples for the case of 8 bit quantization for each channel.

All colours shall be reproduced as a piece of reflective print on one sheet of substrate, as shown in annex F. It shall be repeated for N_S times as specified in equation (1). Spectral reflectance $\rho(\lambda)$ of each reproduced colour patch shall be measured by the spectrophotometer in accordance with the specification in 5.3.2.

6.3 Presentation of the result

The spectral reflectance, $\bar{\rho}(\lambda)$, averaged at each wavelength, for the primary saturated colours, the secondary saturated colours, and black and white shall be plotted as in figure 1.

The measured spectral reflectance of each colour shall be converted to the CIE 1931 XYZ values using equation (2), and the CIELAB values in the CIE 1976 $L^*a^*b^*$ colour space shall be calculated from the tristimulus values in the CIE 1931 XYZ colour space in accordance with equation (3). The CIELAB values shall be averaged as in equation (5) and entered in the form shown in table A.1 (a) at the column positions specified in table 1.

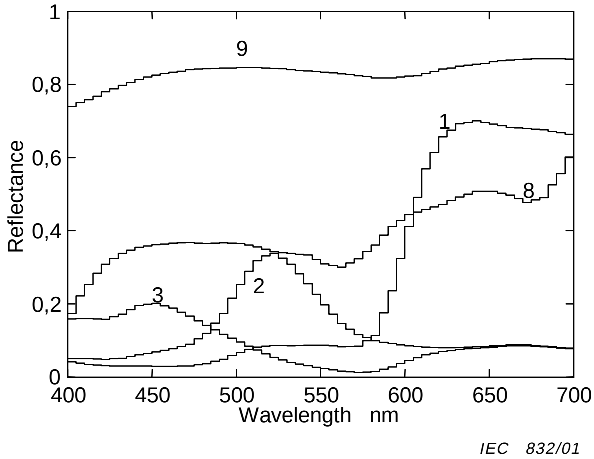

Figure 1a – Spectral reflectance of the primary saturated colours, grey and white

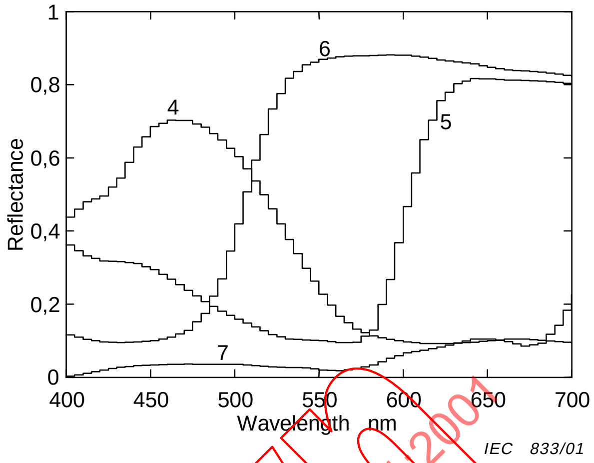

Figure 1b – Spectral reflectance of the secondary saturated colours and black

NOTE Identification numbers of the plots are the same as in table 1.

Figure 1 – Spectral reflectance of the primary and secondary saturated colours, and white, grey and black

7 Basic colorimetric characteristics

7.1 Attribute to be measured

Relationship between the data in red – green – blue in the colour digital image file and reproduced corresponding colours as reflective prints.

7.2 Method of measurement

The colour digital image file containing data for the 6-by-6-by-6 cubic data points specified by the data identification numbers 10 to 225 in table A.1 (b) shall be used. The file shall be processed to obtain a piece of reflective print on one sheet of substrate as an arrangement of colour patches, as shown in annex F, for N_s times, as specified in equation (1).

NOTE The number of the cubic data points may be increased, for example, to account for discontinuities or non-monotonic artefacts indicated in figure 3.

The spectral reflectance of each colour patch of the reflective print should be measured. The measured data shall be calculated according to equation (2). The tristimulus values X, Y and Z shall be converted to the CIELAB colour space, L^*, a^* and b^* in accordance with equation (3), which shall be averaged as in equation (5).

NOTE For simplicity of the measurement procedure, colorimeters may be used to acquire the tristimulus values X, Y and Z directly in accordance with the specification in 5.3.2.

7.3 Presentation of the results

Results of the measurement followed by the calculation shall be entered in the corresponding column positions of table A.1 (b). The reported CIELAB values shall also be plotted as in figure 2.

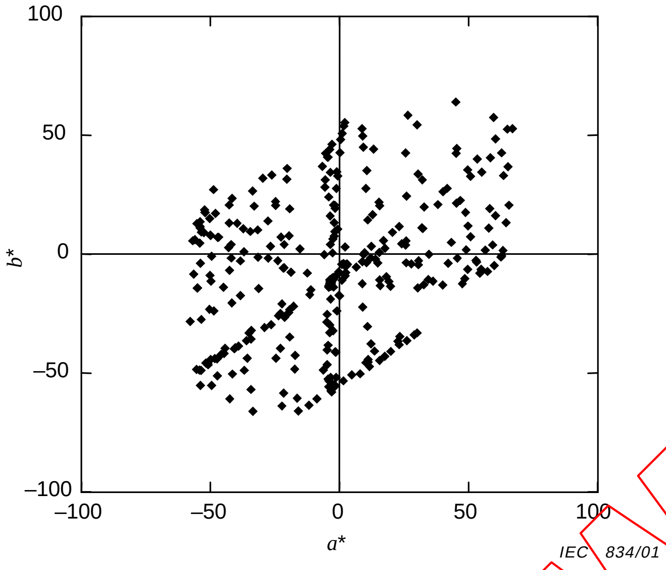

Figure 2a – Gamut of colours in b^* versus a^* plane

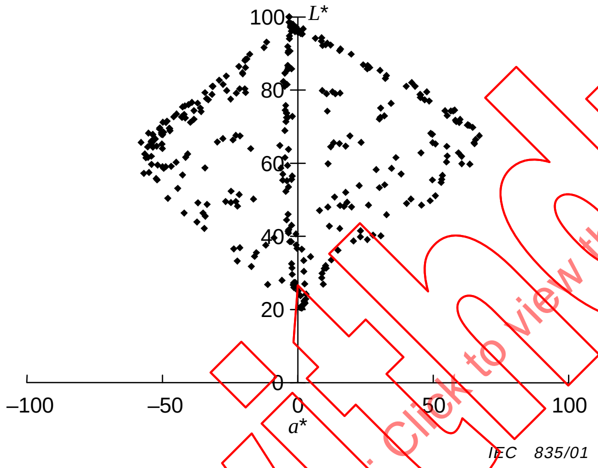

Figure 2b – Gamut of colours in L^* versus a^* plane

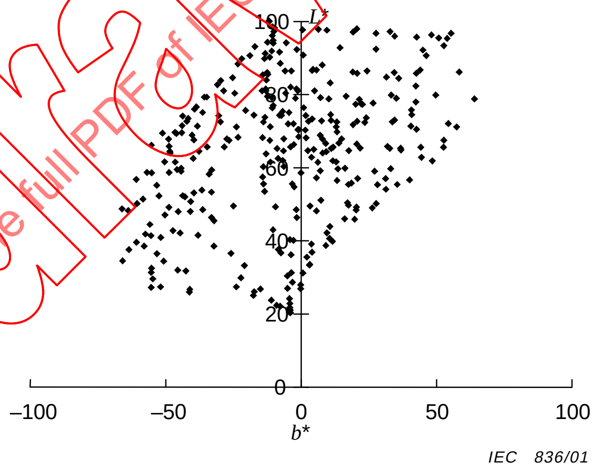

Figure 2c – Gamut of colours in L^* versus b^* plane

NOTE The relationship between the input (R, G, B) and output (L^*, a^*, b^*) colour spaces should also be formulated for use in colour management as shown in annex D using the tri-linear interpolation.

Figure 2 – Example plots for gamut of colours in the CIE 1976 $L^*a^*b^*$ colour space

8 Tone reproduction characteristics

8.1 Attribute to be measured

Relationship between the input data for the primary and secondary colours and black, and the CIE 1976 lightness of the reproduced colours.

8.2 Method of measurement

The colour digital image file containing data specified by table 2 for the input full scale ranges shall be prepared for the primary colours, the secondary colours, and black. Table 2 shows the identification numbers corresponding to table A.1 (c) for each set of colours for reproduction and measurements.

Table 2 – Reference to table A.1 (c)

Colour	Identification numbers	Colour	Identification numbers
Red	From 226 to 240	Magenta	From 286 to 300
Green	From 241 to 255	Yellow	From 301 to 315
Blue	From 256 to 270	Black	From 316 to 336
Cyan	From 271 to 285		

The file shall be processed to obtain a piece of reflective print on one sheet of substrate as an arrangement of colour patches, as shown in annex F, for N_S times, as specified in equation (1).

NOTE The number of cubic data points may be increased, for example, to account for discontinuities or non-monotonic artefacts indicated in figure 3.

The spectral reflectance of each colour patch of the reflective print shall be measured and the measured data shall be calculated according to equation (2). One of the tristimulus values, Y, shall be converted to the lightness L^* in the CIELAB colour space in accordance with equation (3). The lightness L^* shall be averaged as in equation (5).

NOTE For simplicity of the measurement procedure, colorimeters may be used to acquire one of the tristimulus values Y directly in accordance with the specification in 5.3.2.

8.3 Presentation of the results

The measured and calculated results, including the rest of the CIELAB values shall be reported in the columns specified in table 2 to table A.1. The averaged lightness L^* versus normalized input data shall also be reported as the plots shown in figure 3, where normalized input data for red and cyan is $(2R+G+B)/4$, for green and magenta is $(R+2G+B)/4$ and for black is $(R+G+B)/3$.

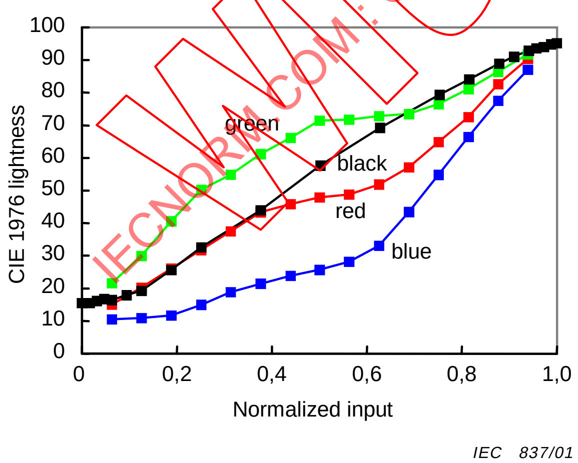

Figure 3a – Tone reproduction for red, green, blue and black

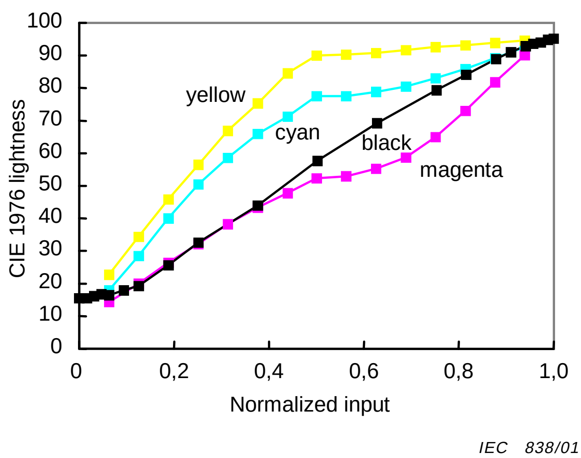

Figure 3b – Tone reproduction for cyan, magenta, yellow and black

NOTE Output characteristics such as lightness versus chroma may be reported to show gradiations.

Figure 3 – An example of reporting tone reproduction characteristics

9 Spatial non-uniformity characteristics

9.1 Attribute to be measured

Non-uniformity of achromatic image reproduced within one sheet of substrate.

9.2 Method of measurement

The data in the achromatic digital image file for this measurement shall be 80 % of the full scale for red – green – blue.

The size of the substrate shall be either A4 defined by ISO 216 or letter size[1]. If the other size is recommended by the manufacturer of the equipment that reproduces the reflective print, it shall be reported together with the presentation of the results of measurements.

The location of the measurement points should be defined from top-left of the substrate in landscape and 15 mm ± 2 mm distance to the bottom-right repeatedly until the next data point is outside of the substrate. An example of the points is shown in table B.1. If the location of data points is different from the recommendation, it shall be reported together with the presentation of the results of measurements.

The spectral reflectance of the reproduced achromatic image should be measured and the acquired data shall be calculated according to equation (2). The tristimulus values X, Y and Z shall be converted to the CIE 1976 L^*, a^*, b^* colour space in accordance with equation (3).

NOTE For simplicity of the measurement procedure, colorimeters may be used to acquire the tristimulus values X, Y and Z directly in accordance with the specification in 5.3.2.

9.3 Presentation of the result

Results of the measurement followed by the calculation shall be filled in to the corresponding columns of table B.1. The colour differences from the average of the CIELAB values $\Delta E^*_{ab_i}$ at the position i shall also be calculated and reported in table B.1, where the colour difference shall be

$$\Delta E^*_{ab_i} = \sqrt{\left(L_i^* - \overline{L^*}\right)^2 + \left(a_i^* - \overline{a^*}\right)^2 + \left(b_i^* - \overline{b^*}\right)^2}$$

The metric N_u for use in equation (1) shall also be calculated by the following equation (7):

$$N_u = \sqrt{\frac{1}{n}\sum_{i=1}^{n} \Delta E^{*2}_{ab_i}} \qquad (7)$$

where n is the number of positions of the measurement.

NOTE The other colour difference based on CIE 116 may also be reported.

[1] A paper size used only in North America.

10 Temporal instability characteristics

10.1 Short-term instability

10.1.1 Attribute to be measured

Colour variation amongst successive reflective prints.

10.1.2 Method of measurement

A colour digital image data as combinations of data 0 % – 50 % – 100 % for each of red, green and blue shall be prepared as specified in table C.1 for $1 \le j \le 27$. The colour digital image file containing 27 colour images in a single page shall be processed to obtain printed samples in accordance with a basic sampling sequence. The basic sampling sequence shall consist of seven printing jobs corresponding to the sequence number $1 \le i \le 7$ in table C.1. The basic sampling sequence shall be conducted under each of the environmental conditions $1 \le k \le 4$ as specified in table 3.

Table 3 – Conditions for sampling and measurements

Conditions (k)	Ambient temperature	Relative humidity
1	20 °C ± 5 °C	65 % ± 10 %
2	30 °C ± 5 °C	85 % ± 10 %
3	10 °C ± 5 °C	15 % ± 10 %
4	20 °C ± 5 °C	65 % ± 10 %

NOTE It should be noted that atmospheric pressure remains in the range from 86 kPa to 106 kPa during the four environmental conditions in table 3.

The number of reflective prints M for each sampling sequence for the first and the seventh printing jobs should be $M = \text{round}(10p)$, where p is the printing speed of the colour printer under measurement in terms of the number of reflective prints per minute, and should be $M = \text{round}(3p)$ for the rest of the printing jobs (from the second to the sixth printing job).

NOTE Only the first and the last prints under each environmental condition may be allowed to be used in order to simplify the measurement procedure.

In order to initiate the basic sampling sequence, the colour printer under measurement shall be powered off for at least one day to acclimate the colour printer to each of the environmental conditions in table 3. The first printing job in the sequence shall be started after the colour printer has been powered on and warmed up in accordance with the manufacturer's specifications. The rest of the printing jobs shall be conducted with the time interval of four to five minutes.

NOTE In the case where the colour printer shuts down at the i-th printing job in the basic sampling sequence due to any trouble, the sampling sequence should be resumed from the beginning of the i-th printing job after fixing the trouble.

The spectral reflectance of each of the reproduced colour images should be measured by the spectrophotometer. The measured spectral data shall be calculated in accordance with equation (2). The tristimulus values X, Y and Z shall be converted to the CIE 1976 L^*, a^*, b^* colour space in accordance with equation (3) which shall further be averaged over the number of reproduced colour images under the same colour (j) and the same environmental condition (k).

All reproduced colour images, except the set of colour prints obtained in the seventh printing job under the environmental condition $k = 4$, shall be discarded. The spectral reflectance of the colour patches for $1 \le j \le 27$ of the number of prints M_7 for $k = 4$ and $i = 7$ should be measured by the spectrophotometer. The measured spectral data shall be calculated in accordance with equation (2).

NOTE For simplicity of the measurement procedure, colorimeters may be used to acquire the tristimulus values X, Y and Z directly in accordance with the specification in 5.3.2.

10.1.3 Presentation of the result

The averaged CIELAB values, L^*, a^* and b^* shall be filled in to the corresponding columns of table C.1 together with the environmental condition k. The colour difference $\Delta E^*_{ab_{ij}}$ for the i-th sampling sequence and for the j-th image shall be calculated as follows and reported in table C.1.

$$\Delta E^*_{ab_{ij}} = \sqrt{\left(L^*_{ij} - \overline{L^*_j}\right)^2 + \left(a^*_{ij} - \overline{a^*_j}\right)^2 + \left(b^*_{ij} - \overline{b^*_j}\right)^2}$$

where $\overline{L^*_j}$, $\overline{a^*_j}$ and $\overline{b^*_j}$ are the averages calculated as follows:

$$\overline{L^*_j} = \frac{1}{7}\sum_{i=1}^{7} L^*_{ij}$$

$$\overline{a^*_j} = \frac{1}{7}\sum_{i=1}^{7} a^*_{ij}$$

$$\overline{b^*_j} = \frac{1}{7}\sum_{i=1}^{7} b^*_{ij}$$

Based on the reported results in table C.1 under the environmental condition for $k = 4$, the metric N_t for use in equation (1) shall also be calculated by the following equation (8).

$$N_t = \sqrt{\frac{1}{27}\sum_{j=1}^{27} \Delta E^{*2}_{ab_{7j}}} \qquad (8)$$

NOTE The other colour difference based on CIE 116 may also be reported.

10.2 Long-term instability

10.2.1 Attribute to be measured

Colour image instability of the reflective prints under light exposure or light fastness.

10.2.2 Method of measurement

The colour digital image file containing data for the saturated primary colours, the secondary colours, the peak white and the peak black shall be prepared as shown in table 4. The file shall be processed to obtain each colour image printed on one sheet of the substance.

Each of the printed colour images shall be cut in half at the beginning to have two sets of the samples. The first set shall be kept in a dark environment at a temperature of 20 °C ± 5 °C, a relative humidity of 65 % ± 10 %, and at atmospheric pressure from 86 kPa to 106 kPa. The second set shall be placed underneath a sodium glass plate of thickness 6 mm and shall be kept exposed under a xenon lamp giving an irradiance of 0,22 W/m^2 at the wavelength 340 nm, for a duration of seven days, at a temperature of 20 °C ± 5 °C, a relative humidity of 65 % ± 10 %, and at atmospheric pressure from 86 kPa to 106 kPa.

NOTE When any of the values do not match the specification, the actual values of irradiance of the light source and exposing time should be reported together with the presentation of the results of measurements.

The spectral reflectance of each colour image should be measured by the spectrophotometer at the beginning and after seven days. The values in the CIELAB colour space for each colour images in the first set shall be calculated in accordance with equations (2) and (3).

The values in the CIELAB colour space for each colour image in the second set should also be calculated based on spectral reflectance, in accordance with equations (2) and (3), every 24 h for seven days. If the time interval is more than the specification, it shall be reported together with the presentation of the results.

NOTE For simplicity of the measurement procedure, colorimeters may be used to acquire the tristimulus values X, Y and Z directly in accordance with the specification in 5.3.2.

10.2.3 Presentation of the result

The data in the CIE 1976 $L^*a^*b^*$ colour space, together with the colour difference from the initial data in CIELAB colour space shall be reported in table 4 as functions of time (or days).

The environmental conditions during measurement and sampling shall be reported together with the presentation of the results of measurements.

Table 4 – Specification of data in the colour digital image file and the form for reporting the result in the long-term instability measurement

Set	Lap-time (days)	R	0 %	100 %	100 %	0 %	100 %	0 %	0 %	100 %
		G	100 %	0 %	100 %	0 %	0 %	100 %	0 %	100 %
		B	100 %	100 %	0 %	0 %	0 %	0 %	100 %	100 %
1st	0	L^*								
		a^*								
		b^*								
	7	L^*								
		a^*								
		b^*								
2nd	0	L^*								
		a^*								
		b^*								
	1	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	2	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	3	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	4	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	5	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	6	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								
	7	L^*								
		a^*								
		b^*								
		ΔE^*_{ab}								

11 Dependency on illuminants characteristics

11.1 Attribute to be measured

Colour fidelity against the change of illuminants.

11.2 Method of measurement

The colour digital image file containing data for the saturated primary colours, the secondary colours, the peak white and the peak black shall be prepared. The reference to the identification numbers in the colour digital image file specified in table A.1 (a) is shown in table 5.

Table 5 – Specification of colour patches

Peak colours	Index (j)	Identification number in table A.1 (a)
Cyan	1	4
Magenta	2	5
Yellow	3	6
Black	4	7
Red	5	1
Green	6	2
Blue	7	3
White	8	9

The file shall be processed to obtain all colour images printed on one sheet of the substrate for N_s times as specified in equation (1). The spectral reflectance of each colour image shall be measured by the spectrophotometer. The tristimulus values shall be calculated in accordance with equation (2) for such illuminants $S(\lambda)$ as,

a) illuminant D50 defined by table 1.1 of CIE 15.2,

b) illuminant A defined by ISO/CIE 10526,

c) illuminant D65 defined by ISO/CIE 10526,

d) illuminant F11 defined by table 3.1 of CIE 15.2.

NOTE Additional illuminants may be allowed for calculation and report.

The corresponding CIELAB values in accordance with equation (3) shall be calculated and averaged as in equation (5).

The relative CIELAB values $\tilde{L}^*$, $\tilde{a}^*$ and $\tilde{b}^*$ in reference to X_W, Y_W and Z_W under the illuminant D50 shall also be calculated in accordance with equation (4) and averaged as in equation (5).

NOTE If any other illuminants are used for the reference, they shall be reported together with the calculated values.

11.3 Presentation of the results

The calculated values in the CIE 1976 $L^*a^*b^*$ colour space, together with the colour differences as in equation (7) shall be reported in table 6 as the measures for colour fidelity under different illuminations.

$$\Delta E^*_{ab_{ij}} = \sqrt{\left(L^*_{ij} - L^*_{D50\,j}\right)^2 + \left(a^*_{ij} - a^*_{D50\,j}\right)^2 + \left(b^*_{ij} - b^*_{D50\,j}\right)^2}$$
$$\Delta \tilde{E}^*_{ab_{ij}} = \sqrt{\left(\tilde{L}^*_{ij} - \tilde{L}^*_{D50\,j}\right)^2 + \left(\tilde{a}^*_{ij} - \tilde{a}^*_{D50\,j}\right)^2 + \left(\tilde{b}^*_{ij} - \tilde{b}^*_{D50\,j}\right)^2} \quad (7)$$

where the index i is for the illuminants A, D65 and F11, the index $1 \le j \le 8$ is for the colours in tables 5 and 6.

NOTE The other colour difference based on CIE 116 may also be used in reporting.

Table 6 – Specification of data in the colour digital image file and the form of reporting the result of dependency on illuminants measurement

(a) CIELAB values

	No.(j)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Illuminant	R	0 %	100 %	100 %	0 %	100 %	0 %	0 %	100 %
or	G	100 %	0 %	100 %	0 %	0 %	100 %	0 %	100 %
light source	B	100 %	100 %	0 %	0 %	0 %	0 %	100 %	100 %
D50	L^*								
	a^*								
	b^*								
A	L^*								
	a^*								
	b^*								
	ΔE^*_{ab}								
D65	L^*								
	a^*								
	b^*								
	ΔE^*_{ab}								
F11	L^*								
	a^*								
	b^*								
	ΔE^*_{ab}								

(b) Relative CIELAB values

	No.(j)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Illuminant	R	0 %	100 %	100 %	0 %	100 %	0 %	0 %
or	G	100 %	0 %	100 %	0 %	0 %	100 %	0 %
light source	B	100 %	100 %	0 %	0 %	0 %	0 %	100 %
D50	$\tilde{L}^*$							
	$\tilde{a}^*$							
	$\tilde{b}^*$							
A	$\tilde{L}^*$							
	$\tilde{a}^*$							
	$\tilde{b}^*$							
	$\Delta\tilde{E}^*_{ab}$							
D65	$\tilde{L}^*$							
	$\tilde{a}^*$							
	$\tilde{b}^*$							
	$\Delta\tilde{E}^*_{ab}$							
F11	$\tilde{L}^*$							
	$\tilde{a}^*$							
	$\tilde{b}^*$							
	$\Delta\tilde{E}^*_{ab}$							

Annex A
(normative)

The values in the colour digital image file

Table A.1 specifies the identification numbers for each set of red (R) – green (G) – blue (B) data and the form to be used to report the measured results. The table shall be applicable for measurements in clauses 6, 7 and 8. Reproduced reflective print as an array of colour images is shown in annex F.

NOTE The actual data are shown just for information in the case of 8 bits quantization for each of R, G, and B channels.

Table A.1 – Specification of the colour digital image file and the form for reporting
(a) Primary colours

No.	D_R	D_G	D_B	L^*	a^*	b^*
1	255	0	0			
2	0	255	0			
3	0	0	255			
4	0	255	255			
5	255	0	255			
6	255	255	0			
7	0	0	0			
8	128	128	128			
9	255	255	255			

(b) 6-by-6-by-6 cubic data

No.	D_R	D_G	D_B	L^*	a^*	b^*
10	0	0	0			
11	0	0	51			
12	0	0	102			
13	0	0	153			
14	0	0	204			
15	0	0	255			
16	0	51	0			
17	0	51	51			
18	0	51	102			
19	0	51	153			
20	0	51	204			
21	0	51	255			
22	0	102	0			
23	0	102	51			
24	0	102	102			
25	0	102	153			
26	0	102	204			
27	0	102	255			
28	0	153	0			
29	0	153	51			
30	0	153	102			
31	0	153	153			
32	0	153	204			
33	0	153	255			
34	0	204	0			
35	0	204	51			
36	0	204	102			
37	0	204	153			
38	0	204	204			
39	0	204	255			
40	0	255	0			
41	0	255	51			
42	0	255	102			
43	0	255	153			

Table A.1 (b) (*continued*)

No.	D_R	D_G	D_B	$L*$	$a*$	$b*$
44	0	255	204			
45	0	255	255			
46	51	0	0			
47	51	0	51			
48	51	0	102			
49	51	0	153			
50	51	0	204			
51	51	0	255			
52	51	51	0			
53	51	51	51			
54	51	51	102			
55	51	51	153			
56	51	51	204			
57	51	51	255			
58	51	102	0			
59	51	102	51			
60	51	102	102			
61	51	102	153			
62	51	102	204			
63	51	102	255			
64	51	153	0			
65	51	153	51			
66	51	153	102			
67	51	153	153			
68	51	153	204			
69	51	153	255			
70	51	204	0			
71	51	204	51			
72	51	204	102			
73	51	204	153			
74	51	204	204			
75	51	204	255			
76	51	255	0			
77	51	255	51			
78	51	255	102			
79	51	255	153			
80	51	255	204			
81	51	255	255			
82	102	0	0			
83	102	0	51			
84	102	0	102			
85	102	0	153			
86	102	0	204			
87	102	0	255			
88	102	51	0			
89	102	51	51			
90	102	51	102			
91	102	51	153			
92	102	51	204			
93	102	51	255			
94	102	102	0			
95	102	102	51			
96	102	102	102			
97	102	102	153			
98	102	102	204			
99	102	102	255			
100	102	153	0			
101	102	153	51			
102	102	153	102			
103	102	153	153			
104	102	153	204			
105	102	153	255			

Table A.1 (b) (*continued*)

No.	D_R	D_G	D_B	L^*	a^*	b^*
106	102	204	0			
107	102	204	51			
108	102	204	102			
109	102	204	153			
110	102	204	204			
111	102	204	255			
112	102	255	0			
113	102	255	51			
114	102	255	102			
115	102	255	153			
116	102	255	204			
117	102	255	255			
118	153	0	0			
119	153	0	51			
120	153	0	102			
121	153	0	153			
122	153	0	204			
123	153	0	255			
124	153	51	0			
125	153	51	51			
126	153	51	102			
127	153	51	153			
128	153	51	204			
129	153	51	255			
130	153	102	0			
131	153	102	51			
132	153	102	102			
133	153	102	153			
134	153	102	204			
135	153	102	255			
136	153	153	0			
137	153	153	51			
138	153	153	102			
139	153	153	153			
140	153	153	204			
141	153	153	255			
142	153	204	0			
143	153	204	51			
144	153	204	102			
145	153	204	153			
146	153	204	204			
147	153	204	255			
148	153	255	0			
149	153	255	51			
150	153	255	102			
151	153	255	153			
152	153	255	204			
153	153	255	255			
154	204	0	0			
155	204	0	51			
156	204	0	102			
157	204	0	153			
158	204	0	204			
159	204	0	255			
160	204	51	0			
161	204	51	51			
162	204	51	102			
163	204	51	153			
164	204	51	204			
165	204	51	255			
166	204	102	0			
167	204	102	51			
168	204	102	102			
169	204	102	153			
170	204	102	204			
171	204	102	255			

Table A.1 (b) (*continued*)

No.	D_R	D_G	D_B	$L*$	$a*$	$b*$
172	204	153	0			
173	204	153	51			
174	204	153	102			
175	204	153	153			
176	204	153	204			
177	204	153	255			
178	204	204	0			
179	204	204	51			
180	204	204	102			
181	204	204	153			
182	204	204	204			
183	204	204	255			
184	204	255	0			
185	204	255	51			
186	204	255	102			
187	204	255	153			
188	204	255	204			
189	204	255	255			
190	255	0	0			
191	255	0	51			
192	255	0	102			
193	255	0	153			
194	255	0	204			
195	255	0	255			
196	255	51	0			
197	255	51	51			
198	255	51	102			
199	255	51	153			
200	255	51	204			
201	255	51	255			
202	255	102	0			
203	255	102	51			
204	255	102	102			
205	255	102	153			
206	255	102	204			
207	255	102	255			
208	255	153	0			
209	255	153	51			
210	255	153	102			
211	255	153	153			
212	255	153	204			
213	255	153	255			
214	255	204	0			
215	255	204	51			
216	255	204	102			
217	255	204	153			
218	255	204	204			
219	255	204	255			
220	255	255	0			
221	255	255	51			
222	255	255	102			
223	255	255	153			
224	255	255	204			
225	255	255	255			

Table A.1 (*continued*)
(c) Data and form for gradation

No.	D_R	D_G	D_B	L^*	a^*	b^*
226	32	0	0			
227	64	0	0			
228	96	0	0			
229	128	0	0			
230	160	0	0			
231	192	0	0			
232	224	0	0			
233	255	0	0			
234	255	32	32			
235	255	64	64			
236	255	96	96			
237	255	128	128			
238	255	160	160			
239	255	192	192			
240	255	224	224			
241	0	32	0			
242	0	64	0			
243	0	96	0			
244	0	128	0			
245	0	160	0			
246	0	192	0			
247	0	224	0			
248	0	255	0			
249	32	255	32			
250	64	255	64			
251	96	255	96			
252	128	255	128			
253	160	255	160			
254	192	255	192			
255	224	255	224			
256	0	0	32			
257	0	0	64			
258	0	0	96			
259	0	0	128			
260	0	0	160			
261	0	0	192			
262	0	0	224			
263	0	0	255			
264	32	32	255			
265	64	64	255			
266	96	96	255			
267	128	128	255			
268	160	160	255			
269	192	192	255			
270	224	224	255			
271	0	32	32			
272	0	64	64			
273	0	96	96			
274	0	128	128			
275	0	160	160			
276	0	192	192			
277	0	224	224			
278	0	255	255			
279	32	255	255			
280	64	255	255			
281	96	255	255			
282	128	255	255			
283	160	255	255			
284	192	255	255			
285	224	255	255			
286	32	0	32			
287	64	0	64			
288	96	0	96			
289	128	0	128			
290	160	0	160			
291	192	0	192			
292	224	0	224			

Table A.1 (c) (*continued*)

No.	D_R	D_G	D_B	$L*$	$a*$	$b*$
293	255	0	255			
294	255	32	255			
295	255	64	255			
296	255	96	255			
297	255	128	255			
298	255	160	255			
299	255	192	255			
300	255	224	255			
301	32	32	0			
302	64	64	0			
303	96	96	0			
304	128	128	0			
305	160	160	0			
306	192	192	0			
307	224	224	0			
308	255	255	0			
309	255	255	32			
310	255	255	64			
311	255	255	96			
312	255	255	128			
313	255	255	160			
314	255	255	192			
315	255	255	224			
316	0	0	0			
317	4	4	4			
318	8	8	8			
319	12	12	12			
320	16	16	16			
321	24	24	24			
322	32	32	32			
323	48	48	48			
324	64	64	64			
325	96	96	96			
326	128	128	128			
327	160	160	160			
328	192	192	192			
329	208	208	208			
330	224	224	224			
331	232	232	232			
332	240	240	240			
333	244	244	244			
334	248	248	248			
335	252	252	252			
336	255	255	255			

Annex B
(normative)

Specification of the measurement positions and the reporting form

Table B.1 specifies the positions in millimetres to be measured for spatial non-uniformity in clause 9. This table also specifies the form to be used to report the measured results. The colour difference is from total averages of the CIELAB values in table B.1.

Table B.1 – Form of reporting with measurement positions

i	Left (mm)	Top (mm)	L^*	a^*	b^*	ΔE^*_{ab}
1	15	15				
2	30	15				
3	45	15				
4	60	15				
5	75	15				
6	90	15				
7	105	15				
8	120	15				
9	135	15				
10	150	15				
11	165	15				
12	180	15				
13	195	15				
14	210	15				
15	225	15				
16	240	15				
17	255	15				
18	270	15				
19	285	15				
20	15	30				
21	30	30				
22	45	30				
23	60	30				
24	75	30				
25	90	30				
26	105	30				
27	120	30				
28	135	30				
29	150	30				
30	165	30				
31	180	30				
32	195	30				
33	210	30				
34	225	30				
35	240	30				
36	255	30				
37	270	30				
38	285	30				
39	15	45				
40	30	45				
41	45	45				
42	60	45				
43	75	45				
44	90	45				
45	105	45				
46	120	45				
47	135	45				
48	150	45				
49	165	45				
50	180	45				
51	195	45				

Table B.1 (*continued*)

i	Left (mm)	Top (mm)	L^*	a^*	b^*	ΔE^*_{ab}
52	210	45				
53	225	45				
54	240	45				
55	255	45				
56	270	45				
57	285	45				
58	15	60				
59	30	60				
60	45	60				
61	60	60				
62	75	60				
63	90	60				
64	105	60				
65	120	60				
66	135	60				
67	150	60				
68	165	60				
69	180	60				
70	195	60				
71	210	60				
72	225	60				
73	240	60				
74	255	60				
75	270	60				
76	285	60				
77	15	75				
78	30	75				
79	45	75				
80	60	75				
81	75	75				
82	90	75				
83	105	75				
84	120	75				
85	135	75				
86	150	75				
87	165	75				
88	180	75				
89	195	75				
90	210	75				
91	225	75				
92	240	75				
93	255	75				
94	270	75				
95	285	75				
96	15	90				
97	30	90				
98	45	90				
99	60	90				
100	75	90				
101	90	90				
102	105	90				
103	120	90				
104	135	90				
105	150	90				
106	165	90				
107	180	90				
108	195	90				
109	210	90				
110	225	90				
111	240	90				
112	255	90				
113	270	90				
114	285	90				

Table B.1 (*continued*)

i	Left (mm)	Top (mm)	L^*	a^*	b^*	ΔE^*_{ab}
115	15	105				
116	30	105				
117	45	105				
118	60	105				
119	75	105				
120	90	105				
121	105	105				
122	120	105				
123	135	105				
124	150	105				
125	165	105				
126	180	105				
127	195	105				
128	210	105				
129	225	105				
130	240	105				
131	255	105				
132	270	105				
133	285	105				
134	15	120				
135	30	120				
136	45	120				
137	60	120				
138	75	120				
139	90	120				
140	105	120				
141	120	120				
142	135	120				
143	150	120				
144	165	120				
145	180	120				
146	195	120				
147	210	120				
148	225	120				
149	240	120				
150	255	120				
151	270	120				
152	285	120				
153	15	135				
154	30	135				
155	45	135				
156	60	135				
157	75	135				
158	90	135				
159	105	135				
160	120	135				
161	135	135				
162	150	135				
163	165	135				
164	180	135				
165	195	135				
166	210	135				
167	225	135				
168	240	135				
169	255	135				
170	270	135				
171	285	135				
172	15	150				
173	30	150				
174	45	150				
175	60	150				
176	75	150				
177	90	150				

Table B.1 (*continued*)

i	Left (mm)	Top (mm)	L^*	a^*	b^*	ΔE^*_{ab}
178	105	150				
179	120	150				
180	135	150				
181	150	150				
182	165	150				
183	180	150				
184	195	150				
185	210	150				
186	225	150				
187	240	150				
188	255	150				
189	270	150				
190	285	150				
191	15	165				
192	30	165				
193	45	165				
194	60	165				
195	75	165				
196	90	165				
197	105	165				
198	120	165				
199	135	165				
200	150	165				
201	165	165				
202	180	165				
203	195	165				
204	210	165				
205	225	165				
206	240	165				
207	255	165				
208	270	165				
209	285	165				
210	15	180				
211	30	180				
212	45	180				
213	60	180				
214	75	180				
215	90	180				
216	105	180				
217	120	180				
218	135	180				
219	150	180				
220	165	180				
221	180	180				
222	195	180				
223	210	180				
224	225	180				
225	240	180				
226	255	180				
227	270	180				
228	285	180				
229	15	195				
230	30	195				
231	45	195				
232	60	195				
233	75	195				
234	90	195				
235	105	195				
236	120	195				
237	135	195				
238	150	195				
239	165	195				
240	180	195				

Table B.1 (*continued*)

i	**Left (mm)**	**Top (mm)**	L^*	a^*	b^*	ΔE^*_{ab}
241	195	195				
242	210	195				
243	225	195				
244	240	195				
245	255	195				
246	270	195				
247	285	195				
248	15	210				
249	30	210				
250	45	210				
251	60	210				
252	75	210				
253	90	210				
254	105	210				
255	120	210				
256	135	210				
257	150	210				
258	165	210				
259	180	210				
260	195	210				
261	210	210				
262	225	210				
263	240	210				
264	255	210				
265	270	210				
266	285	210				

Annex C
(normative)

Specification for the measurement of short-term instability characteristics

Table C.1 – Short-term instability characteristics

Colour (j)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
i	R (%)	0	50	0	0	50	0	50	50	100	0	0	100	0	50	50	0	100	100	50	50	100	0	100	50	100	100	100
	G (%)	0	0	50	0	50	50	0	50	0	100	0	50	100	0	100	50	0	50	100	50	100	100	0	100	50	100	100
	B (%)	0	0	0	50	0	50	50	50	0	0	100	0	50	100	0	100	50	50	50	100	0	100	100	100	100	50	100
1	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{1j}}$																											
2	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{2j}}$																											
3	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{3j}}$																											
4	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{4j}}$																											
5	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{5j}}$																											
6	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{6j}}$																											
7	L^*																											
	a^*																											
	b^*																											
	$\Delta E^*_{ab_{7j}}$																											

Environmental condition: ambient temperature =___°C, relative humidity =__ %.