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22592-1

First edition

**Office equipment — Print quality
measurement methods for colour
prints —**

Part 1:
Image quality measurement methods

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

A list of all parts in the ISO/IEC 22592 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

There are several standard measurement methods to evaluate image quality attributes of printed images formed by office equipment, i.e. colour reproductions, line reproductions, image structures of sharpness and graininess, gloss properties. Included are ISO/IEC 19799, ISO/IEC 24790 and ISO/IEC 29112. ISO/IEC 24790 specifies the measurement methods for large area density uniformity of graininess, mottle and banding, as well as line qualities. ISO/IEC 29112 specifies the methods for measuring sharpness attributes of edge blurriness and raggedness, special frequency response, etc. ISO/IEC 19799 specifies the methods for gloss uniformity. By utilizing these documents, users can obtain consistent test results when they comply with the protocols specified in the documents.

There are no standard methods to measure colour reproduction consistencies and geometrical accuracies in consecutive printing, and image stabilities in typical use case of print images formed by office equipment and used in office environments. In the current state, each printer distributor and its user can provide test results for those attributes measured by its own test methods and procedures, which are often convenient for its product, resulting in misleading customers in the selection of a printing system suitable for their use cases. The ISO/IEC 22592 series can provide standard methods and procedures for these print image attributes: ISO/IEC 22592-1 for colour consistency, ISO/IEC 22592-2 for geometrical accuracies and ISO/IEC 21592-3 for image stabilities. By using these International Standards, consistent and comparable test results suitable for typical use cases of office prints can be obtained independent of data providers.

This document specifies measurement methods that quantitatively evaluate image quality attributes and test charts to measure the attributes as well as the variations in measured attributes in colour prints formed under the environment and stress assuming general office use case. The attributes for duplex colour print sets are within the scope as most of office documents are currently printed in duplex print sets comprising several sheets printed with colour images on both surfaces of substrates.

The measurement methods described in this document are used to access image qualities of a print set formed by a printing system on a substrate. When test results are compared among various printing systems, it is essential to use the same product of substrates and set equivalent printing conditions under default printer settings among the printing systems.

<https://www.iso.org/standard/72592-1> Electrophotography, thermal inkjet, or piezoelectric inkjet technologies are commonly used to form such prints. The purpose of this document is to provide objective measurement methods for image quality attributes of duplex colour print sets.

This document prescribes the following:

- test charts for the measurements which specify colour codes and locations in page to be measured;
- measurement method for colour reproduction range;
- measurement methods for colour variations, including variation by location within a page (within-page variation), variation between front and back side (side-to-side variation), variation among the sheets in the same print set (sheet-to-sheet variation) and variations depending on the colours printed on its back side (show-through variation);
- measurement methods for the attributes of line quality, graininess and mottle based on ISO/IEC 24790 and variations (side-to-side, sheet-to-sheet variations, etc.) in attributes.

The above methods relating to image quality variations are mainly designed to quantify the variations in duplex print sets. On the other hand, it is convenient for users to evaluate simplex print sets, comprising several sheets which are printed with colour images on one surface of a substrate and no image on the other surface, by using the same methods for duplex print sets. Therefore, some attributes for variations, such as colour variations “within a printed image”, “sheet-to-sheet variations”, can also be applicable for a simplex print set.

Measurement methods for gloss and its variations are out of the scope of this document, and have already been specified in ISO/IEC 19799.

In this document colour codes for the test charts are defined in sRGB colour space as specified in IEC 61966-2-1 as is common in office documents colour measurements are based on CIELAB specified in ISO/CIE 11664-4.

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Office equipment — Print quality measurement methods for colour prints —

Part 1: Image quality measurement methods

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of this document. Users should therefore consider printing with a colour printer.

1 Scope

This document specifies test methods as well as test charts to measure the image quality attributes and those variations in colour prints typically used in office environment. Included are digital colour prints formed by using a multifunction or single function printer. Printers supporting a maximum paper size of A4 or larger are suitable for the measurements using the test charts defined in this document.

The image quality attributes included are colour reproduction, line quality, graininess and mottle.

The sources of variation considered are locations in a page (within-page variation), printed side in a sheet (side-to-side variation), printed order of the sheet (sheet-to-sheet variation) and colours printed on the back side of evaluated patch (show-through variation).

A duplex print set, comprising several sheets which are printed by multifunction or single function printer with colour images on both surfaces of a substrate, is a main application of the test methods to measure image quality variations in the set. Variations, such as within-page variation and sheet-to-sheet variation, are also applicable for a simplex print set comprising several sheets which are printed colour images on one surface of a substrate and no image on the other surface.

Both duplex and simplex printers are applicable to form a print set. When image qualities of duplex prints are measured, duplex printers which are capable to print images on both sides of substrate automatically are applicable to form duplex prints. However, simplex printers which require a manual arrangement of substrates between the front side and back side printing to form duplex prints are out of scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO/IEC 24790, *Information technology — Office equipment — Measurement of image quality attributes for hardcopy output — Monochrome text and graphic images*

ISO/CIE 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* colour space*

ISO/CIE 11664-6, *Colorimetry — Part 6: CIEDE2000 colour-difference formula*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 24790 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>.

3.1

back side

print side (3.10) corresponding to an even page of input data

3.2

blurriness

appearance of being hazy or indistinct in outline, a noticeable transition of darkness from line element to background substrate whose intended transition width is zero (i.e. ideally sharp)

[SOURCE: ISO/IEC 24790:2017, 3.5]

3.3

character darkness

appearance of blackness of a line or character image

[SOURCE: ISO/IEC 24790:2017, 3.7]

3.4

colour reproduction range

index corresponding to colour reproduction property of a print taking only input colours of C, M, Y, K and W (blanc area) into account

3.5

front side

print side (3.10) corresponding to an odd page of input data

3.6

graininess

appearance of unintended microscopic, but visible, aperiodic fluctuations of lightness

Note 1 to entry: Microscopic means: variations with spatial frequencies greater than about 0,4 cy/mm.

[SOURCE: ISO/IEC 24790:2017, 3.13]

3.7

line width

average stroke width, where the stroke width is measured from edge to edge along a line normal to the centre line of the image element

[SOURCE: ISO/IEC 24790:2017, 3.23]

3.8

mottle

measure of the appearance of unintended, aperiodic macroscopic fluctuations of lightness

Note 1 to entry: Macroscopic means: variations with spatial frequencies less than about 0,4 cy/mm.

[SOURCE: ISO/IEC 24790:2017, 3.26]

3.9

print set

set of sheets printed in a print operation

3.10**print side**

one of the duplex print surfaces, either *front side* (3.5) or *back side* (3.1)

3.11**raggedness**

appearance of geometric distortion of an edge from its ideal position

Note 1 to entry: An ideal edge should be absolutely straight along the length of the line.

Note 2 to entry: A ragged edge appears rough or wavy rather than smooth or straight.

[SOURCE: ISO/IEC 24790:2017, 3.29]

3.12**sheet-to-sheet variation**

change in an attribute at the same input data on the same *print side* (3.10), either the *front side* (3.5) or *back side* (3.1), within a *print set* (3.9)

3.13**show-through variation**

change in the colour at the same input colour code value caused by the colour image printed on the *back side* (3.1) of the same sheet

3.14**side-to-side variation**

change in an attribute at the same input data in the same sheet between front and *back side* (3.1)

3.15**within-page variation**

change in an attribute at the same input data by location within a page

4 Test charts**4.1 General**

There are three test charts defined in this document. The first is illustrated in [Figure 1](#) for the measurements of colour reproduction, and within-page, side-to-side, sheet-to-sheet variations in colour reproduction. The second is illustrated in [Figure 2](#) for the measurement of show-through variations. The third is illustrated in [Figure 3](#) for the measurement of line quality, graininess and mottle, and those variations. The colour codes of the test charts shall be encoded in standard sRGB, as defined in IEC 61966-2-1, which is commonly used in office documents.

Those test charts are prepared in the PDF file format and can be downloaded from:

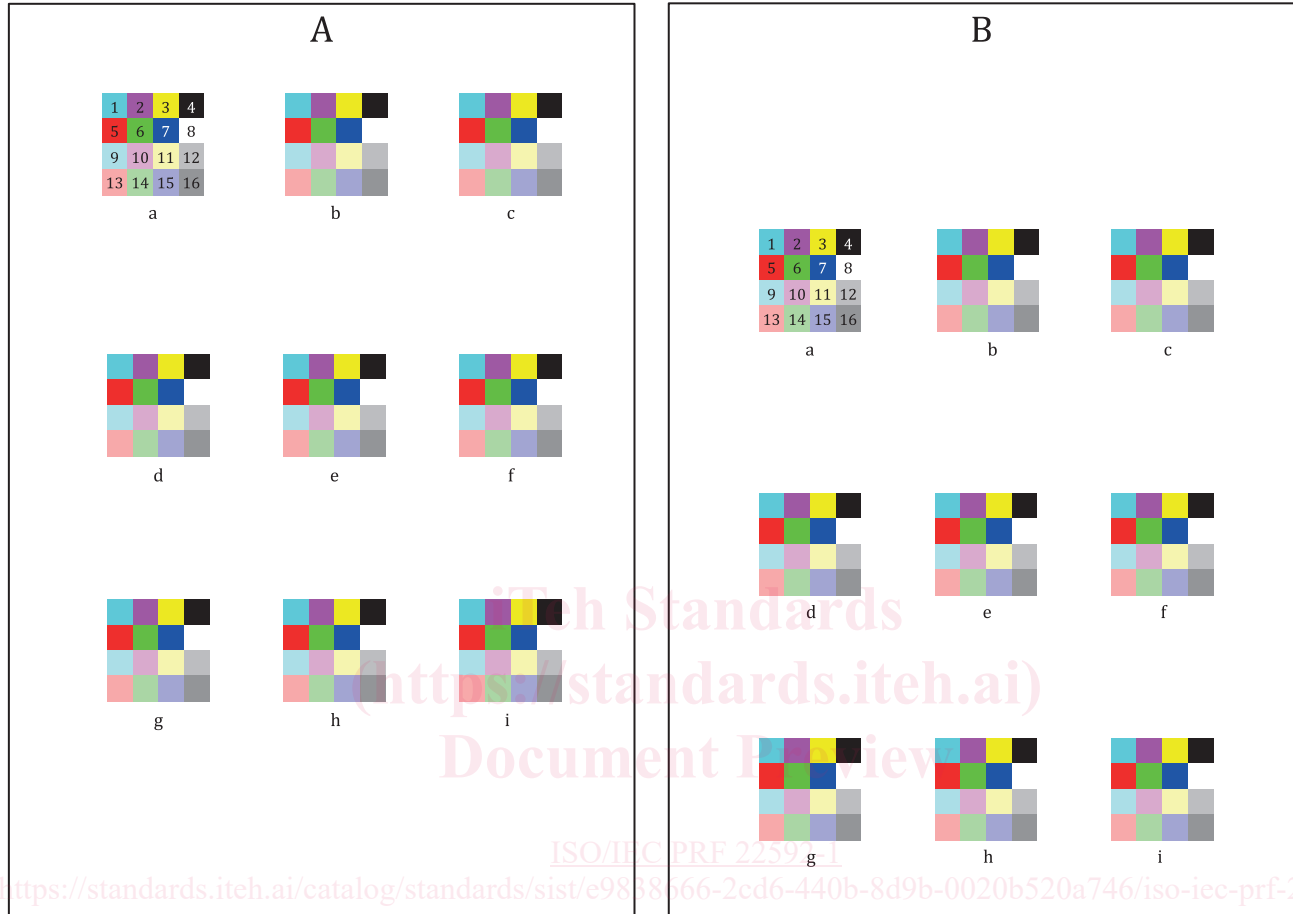
<https://standards.iso.org/iso-iec/22592/-1/ed-1/en/>.

4.2 Test chart for colour reproduction and variations in colour reproduction

The outline of the test chart is described in [Figure 1](#). The test chart is composed of the two images in raster graphics. The first page is used to print an image for front side and the second for back side. The size is A4 for both sides.

Total of nine components, each comprising the 16 patches of cyan (C), magenta (M), yellow (Y), black (K), red (R), green (G), blue (B), white (W), light cyan (LC), light magenta (LM), light yellow (LY), light grey (LK), light red (LR), light green (LG), light blue (LB) and mid grey (MK), are arranged in a print side to evaluate within-page variations. Each component for the back side is shifted by half pitch towards the long-edge direction from the corresponding component for the front side to measure patch colour value without the influence of printed image on its back side.

The sRGB colour codes of those patches are described in [Table 1](#). The colour codes of C, M, Y, K, R, G, B and W patches outline the edge of intended colour reproduction range in the sRGB colour space. Each colour code for the light colour patches of LC, LM, LY, LK, LR, LG and LB is located at 30 % highlight of the corresponding saturated patch (colour code = 178). Colour code for MK is located midpoint between W and K patches.



- Key**
- A frontside
 - B backside
 - a Component A.
 - b Component B.
 - c Component C.
 - d Component D.
 - e Component E.
 - f Component F.
 - g Component G.
 - h Component H.
 - i Component I.

Figure 1 — Illustrated test chart for colour reproduction and its variations

Table 1 — sRGB colour codes of colour patches of test chart for colour reproduction and its variations

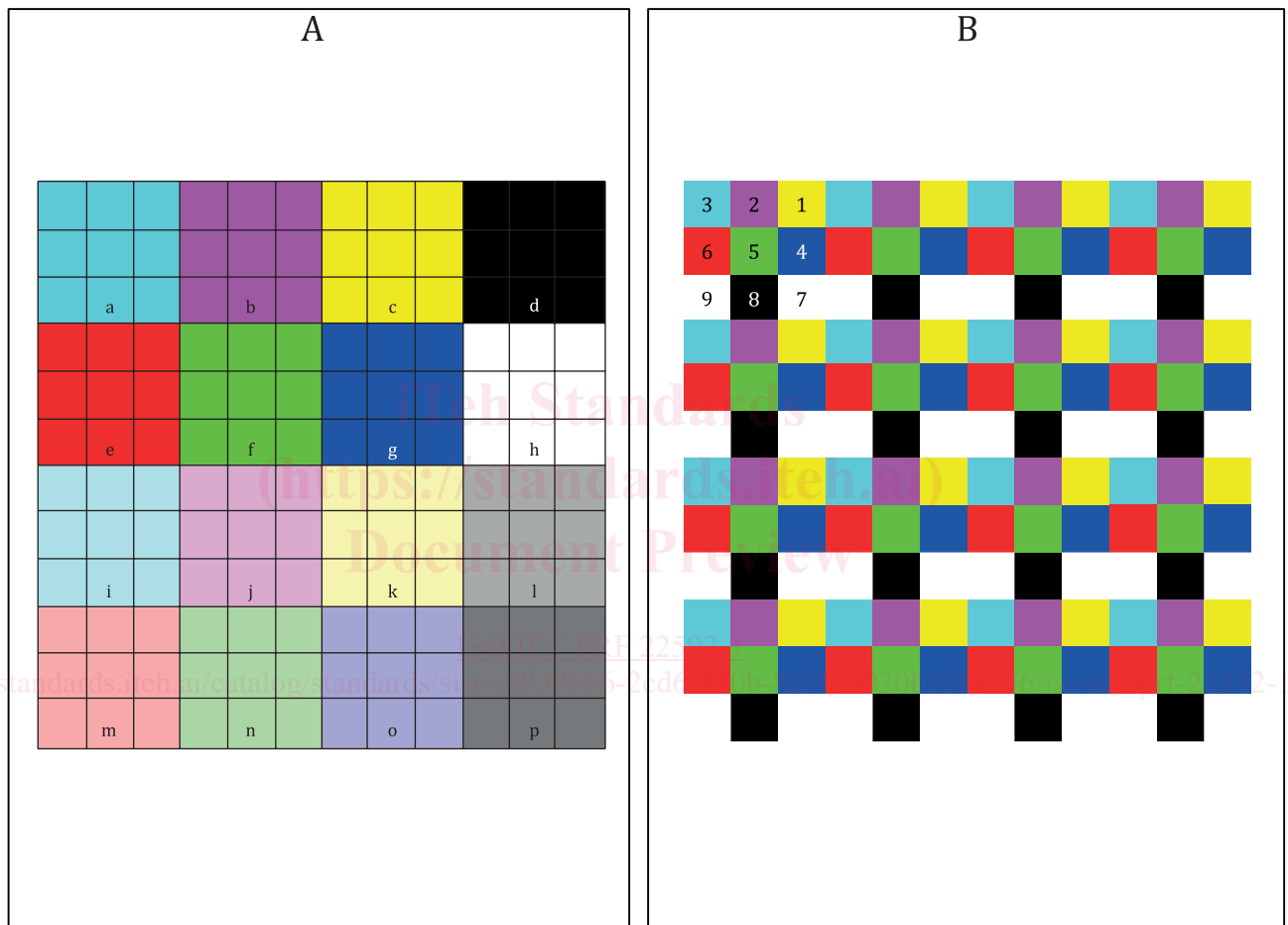
Colour code	C	M	Y	K	R	G	B	W	LC	LM	LY	LK	LR	LG	LB	MK
R	0	255	255	0	255	0	0	255	178	255	255	178	255	178	178	128
G	255	0	255	0	0	255	0	255	255	178	255	178	178	255	178	128
B	255	255	0	0	0	0	255	255	255	255	178	178	178	178	255	128

4.3 Test chart for show-through variations

The outline of the test chart is described in [Figure 2](#). The test chart is composed of the two images in raster graphics. The first page is used to print an image for the front side and the second for the back side. The size is A4 for both sides.

A total of 16 components of C, M, Y, K, R, G, B, W, LC, LM, LY, LK, LR, LG, LB and MK, each comprising the 9 patches of the same colour code, are arranged at the centre of the front side. Each component has the 9 different saturated colour patches of C, M, Y, R, G, B, W, K and W printed on its back side to measure colour values dependence on the back-side colours.

The sRGB colour codes of those patches are the same as those in [4.2](#) as described in [Table 1](#).



Key

A	frontside	h	Component H.
B	backside	i	Component I.
a	Component A.	j	Component J.
b	Component B.	k	Component K.
c	Component C.	l	Component L.
d	Component D.	m	Component M.
e	Component E.	n	Component N.
f	Component F.	o	Component O.
g	Component G.	p	Component P.

Figure 2 — Illustrated test chart for show-through variations