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Information technology — Office equipment — Method of specifying image reproduction of colour copying machines and multifunction devices with copying modes by printed test charts

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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*.

This second edition cancels and replaces the first edition (ISO/IEC 15775:1999), which has been technically revised. It also incorporates the Amendment ISO/IEC 15775:1999/Amd. 1:2005.

The main changes are as follows:

— the title has been changed;

— the scope has been changed;

— the citation of the references has been updated;

— some terms and definitions have been deleted;

— the electronic version of the test charts has been provided;

— the default illuminant has been updated;

— the document has been updated according to the rules in the current ISO/IEC Directives, Part 2.

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

This document is applicable to colour copying machines and multifunction devices with copying modes that produce colour on opaque substrate and the usage is to characterize the performance and limitation of image reproduction quality for comparison.

Information technology — Office equipment — Method of specifying image reproduction of colour copying machines and multifunction devices with copying modes by printed test charts

1 Scope

This document provides requirements for test charts and their use to assess the imaging quality of colour copying machines and multifunction devices with copying modes. This document is applicable to testing of reproduction properties of colour copying machines and multifunction devices having copying function, in order to help to recognize the possibilities and limits of various machines and for their comparison.

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 3664, *Graphic technology and photography — Viewing conditions*

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
colour difference
perceived dissimilarity between two colour stimuli

[SOURCE: ISO/IEC 17823:2015, 2.5]

3.2
lightness
L*
power of a perceived light (inseparably combined with perceived colour)

3.3
Landolt-ring
standard optotype defined by a ring with an open segment which can be in eight different positions

4 Test charts

4.1 General

This document identifies the techniques to manufacture test charts. Four test charts are produced by different manufacturers both in halftone and continuous tone. For the tests according to this document two or more out of eight test charts are used, at least one achromatic test chart (1 or 3) and at least one chromatic test chart (2 or 4).

On each test chart there is a picture area and a frame area around it, see Figure 1. Each of the test charts 1, 2, 3 and 4 contains a form (see Annexes A, B, C, and D respectively) used for visual tests of the picture area and two forms (see Annexes E and F) used for tests of the frame area around it.

At least four forms shall be filled out, two for an achromatic test chart (no. 1: form A and E or no. 3: form C and E) and two for a chromatic test chart (no. 2: form B and F or no. 4: form D and F). The four forms filled out should belong to two test charts both either in halftone or continuous tone.

Colour copying machines are often used for reproduction of achromatic charts. Therefore, an achromatic test chart should also be used for testing colour copying machines.

4.2 Material of test charts

4.2.1 General

The material of test charts depends on whether the chart is halftone or continuous tone.

4.2.2 Examples of material for halftone test charts available as ISO 15775 test charts

Test chart 1: photographic paper for black and white pictures, glossy, 85 g/m^2

Test chart 2: fine art paper, glossy, natural white, non-fading, 100 % non-chlorine bleached, 150 g/m^2

Test chart 3: fine art paper, glossy, natural white, non-fading, 100 % non-chlorine bleached, 150 g/m^2

Test chart 4: fine art paper, glossy, natural white, non-fading, 100 % non-chlorine bleached, 150 g/m^2

For the characteristic of example production, see Table L.1 in Annex L.

4.2.3 Examples of materials for continuous tone test charts available as ISO 15775 test charts

Test chart 1: photographic paper for colour pictures, glossy, 225 g/m^2

Test chart 2: photographic paper for colour pictures, glossy, 225 g/m^2

Test chart 3: photographic paper for colour pictures, glossy, 225 g/m^2

Test chart 4: photographic paper for colour pictures, glossy, 225 g/m^2

For the characteristic of example production see Table L.2 in Annex L.

4.3 Layout of test charts

4.3.1 General

The layout of the test charts is defined in the standard format A4 (297 mm × 210 mm) within PostScript (PS)-files (or equivalent). The following layout is reduced to half size. The layout in standard format A4 can be found on the ISO maintenance portal (see Annex M). Figures 1 to 3 show the layout and in Figures 4 to 7 the content is shown.

4.3.2 Basic layout of the picture area and the frame area around

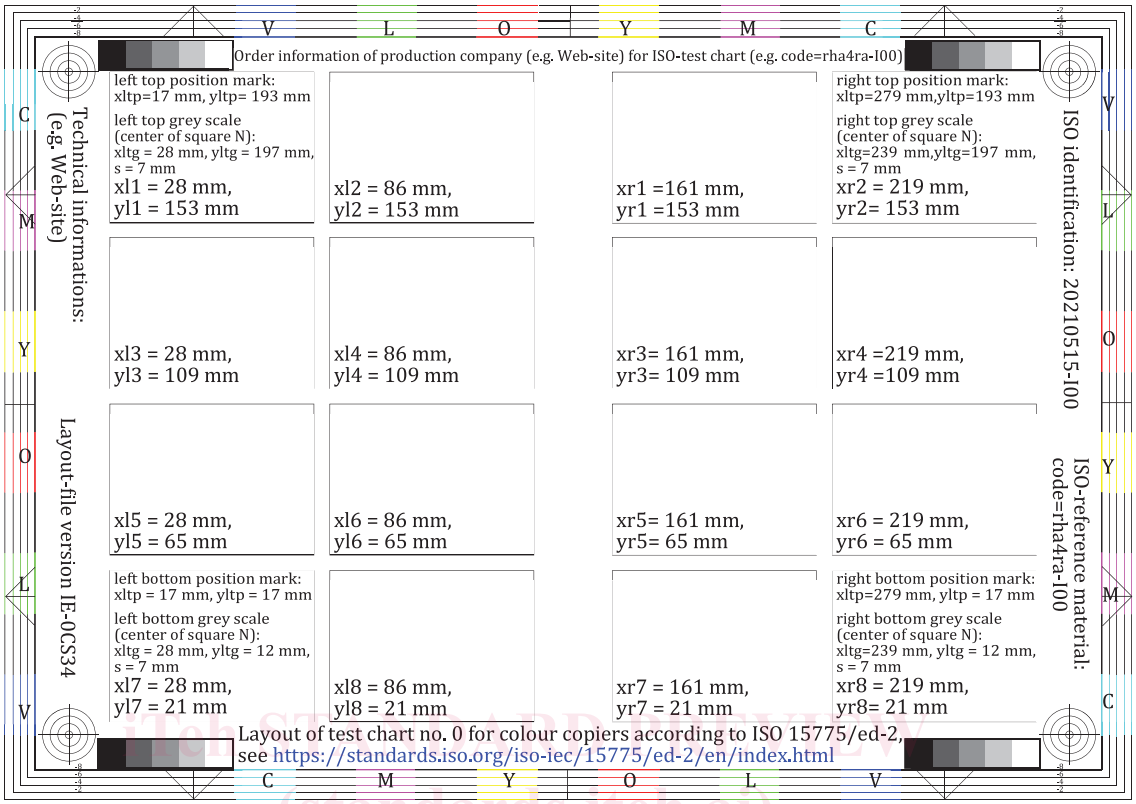

Figure 1 — Basic layout of the figures and the frame area around

Figure 1 shows the basic layout of the test charts which includes in the central area the layout of 16 pictures (without content) and in the frame area around text and other elements. The basic format is A4 (297 mm × 210 mm) described by the outer rectangle. The inner rectangle has a thicker line (0,30 mm instead of 0,15 mm) and the size is 282 mm × 194 mm.

Figure 1 includes *x*- and *y*-data in mm for all test elements shown with an arrow point at the left bottom corner of the format A4. One can find the *x*- and *y*-data of:

— left bottom corner of 16 pictures,

— four position marks,

— centre of four squares with black colours N of a 5-step grey scale,

— five rectangles located 2 mm up and to the right compared to the outer one and 4 mm smaller on both sides.

NOTE 1 Arrows help to detect the distance to the outer rectangle of the format A4. There is no visual test based on arrows within this document.

NOTE 2 There are some additional lines dividing the format A4 in four equal formats A6. There is a need to get the pixel picture B1 (equal to D1) in the format A6 and on slide and negative film for special applications. The four parts of the format A6 can be mounted to one part of the format A4 if this is useful for special applications.

NOTE 3 The position marks allow exact positioning of colourimeters to measure the *L*a*b** colourimetric data for the colour samples in the test charts. Figures 2 and 3 include the position data of all samples in all test charts and simplify colourimetric measurements.

4.3.3 Layout of the picture area and the frame area around of test charts 1 to 4

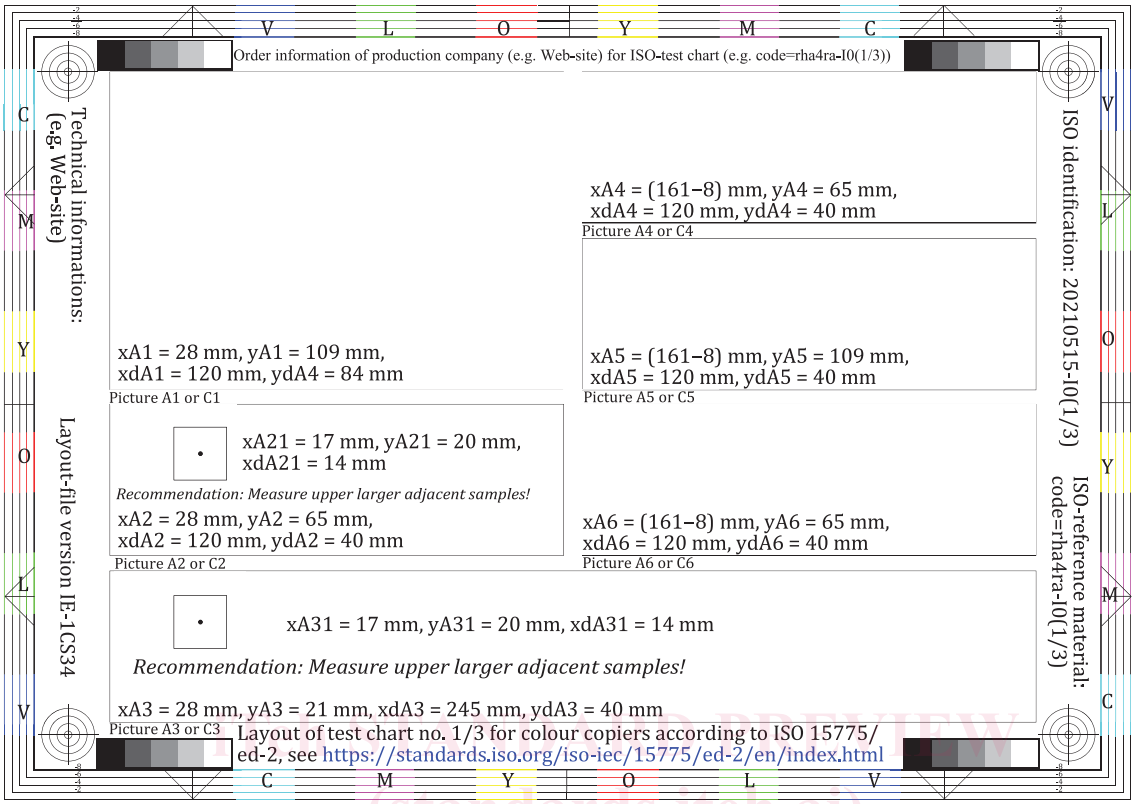

Figure 2 — Layout of picture and frame area of test charts 1 and 3

Figure 2 shows the layout of test charts 1 and 3 with six pictures and a frame area around. The layout of the pictures and the frame area is very similar to the basic layout of Figure 1. Instead of 16 there are now six pictures A1 to A6 and C1 to C6 in test charts 1 and 3 respectively.

Within the area of pictures A2 and A3 there is a square which represents the first sample (black) of the 5-step and 16-step grey scales. The *x*- and *y*-data of the square centre is given relative to the left bottom corner of pictures A2 and A3. The grey sample distance of the 5- or 16-step grey series is 14 mm.

NOTE There are two additional samples which appear black (N_0) and white (W_1). In digital PS-files (or equivalent) absolute or relative colourimetric space with lightness L^* or $l^*_{relative} = (L^* - L^*_N) / (L^*_W - L^*_N)$ can be used. The colourimetric data $L^* = 0$ and $L^* = 100$ produce the darkest black (N_0) and lightest white (W_1) on the material used, which can be different compared to L^*_N and L^*_W of the contrast range.

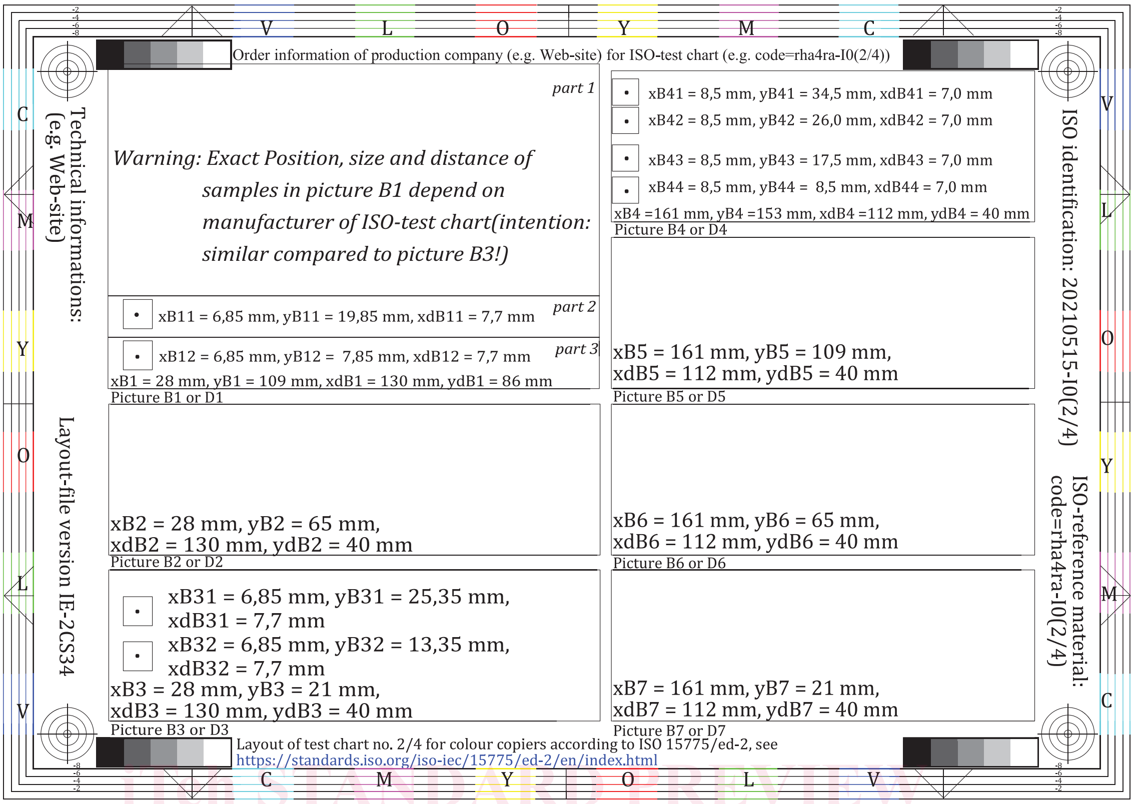

Figure 3 — Layout of picture and frame area of test charts 2 and 4

Figure 3 shows the layout of test charts 2 and 4 with seven pictures and a frame area around. The layout of the pictures and the frame area is very similar to the basic layout of Figure 1. Instead of 16 there are now seven pictures B1 to B7 and D1 to D7 in test charts 2 and 4 respectively.

Within the pictures B1 and B3 (or D1 and D3) there are two squares which represent the first CIE-test colour and the black sample of the 16-step grey scale. The *x*- and *y*-data of the square centres are given relative to the left bottom corner of pictures B1 and B3 (D1 and D3). The sample distance of the steps is 7,7 mm.

Within the picture B4 (or D4) there are four squares which represent the first samples of colour series *W–C*, *W–M*, *W–Y*, and *W–N* (or *W–O*, *W–L*, *W–V*, and *W–N*). The sample distance of the steps is 7,0 mm.

4.3.4 Restrictions for layout and content of picture B1

In picture B1 of test chart 2 (which is identical to picture D1 of test chart 4) the subject matter may be chosen by the manufacturer. Any picture which satisfies the following restrictions is allowed for an ISO-test chart manufacturer:

The picture B1 consists of three parts (compare layout of picture B1 in Figure 5).

Restrictions for the three parts of the picture B1:

Part 1: the picture shall include a large variety of colours in the upper part (130 mm × 60 mm);

Part 2: shall include 14 CIE-test colours plus black N_0 (darkest black) and white W_1 (whitest white) (130 mm × 11 mm);

Part 3: shall include a 16-step equidistant grey scale between black *N* (L^*_N = 10) and white *W* (L^*_W = 94) (130 mm × 15 mm).

NOTE 1 An ISO-test chart manufacturer can add in part 1 a black and white Siemens-star equal in size and colour (L^*_N and L^*_W) to the Siemens-star *N*–*W* of picture B2. A user will get important information about the actual resolution of identical Siemens-stars by the pixel image (picture B1) and direct vector-based reproduction (picture B2).

The intended colourimetric data for the 14 CIE-test colours and the 16-step equidistant grey samples are equal to the intended data of these colours in picture B3.

NOTE 2 The photographic process (film material, taken illuminant exposure, development) used to take the picture B1 (with the three parts in one exposure) and the scanning process producing the digital image will result in different CIE-test colours and grey samples in pictures B1 and B3.

NOTE 3 By a least squares technique, a transformation of the digital image data (e.g. *RGB*) is used to calculate *L*a*b** colourimetric data. If the *L*a*b**-data of picture B1 are equal within 3 CIELAB units to the *L*a*b**-data of picture B3 then the colours in picture B1 and B3 appear equal.

4.3.5 Restrictions for digital image data and resolution of picture B1

ISO-test chart manufacturers shall publish *RGB*-image data of the picture B1 in five resolutions: 192 × 128, 384 × 256, 786 × 512, 1 536 × 1 024, and 3 072 × 2 048.

NOTE 1 *RGB*-image data in these five resolutions can be, for example, produced by the Kodak Photo CD[1)]-process with the option "Transfer to EPS (Encapsulated PostScript) (or equivalent) with 24 bit colour".

NOTE 2 A transformation from *RGB*-image data to *L*a*b**-image data can be recommended by the ISO-test chart manufacturer.

NOTE 3 In ISO-test charts within the header of the EPS-file (or equivalent) of the picture B1, numerical data of a 3 × 4 matrix transform are given. The transformation from *RGB*-image data to *L*a*b**-image data can be (for example) calculated by a PS-interpreter (or equivalent).

NOTE 4 The transformation from *RGB*-image data to *L*a*b**-image data is the same for all image resolutions. The lowest resolution can be used to get a table of the *RGB*-image data of the 32 colours (14 CIE-test colours + N_0 + W_1 and the 16-step grey samples).

NOTE 5 The intended CIE-test and grey colours are known. This allows to calculate an optimized transformation from *RGB*-image data to *L*a*b**-image data.

NOTE 6 For negative film between two stops underexposure and three stops overexposure the *RGB*-image data are very different. An optimized transform leads to *L*a*b**-image data which produce very similar output.

4.3.6 Restrictions for producing ISO-test charts in halftone technique

A test pattern producer can use any line screen and shall disclose the line screen used. The line screen used shall be described by a complete definition of the halftone type.

The halftone type definition includes either the entries:

— "width, height and threshold" of "HalftoneType 3" and/or

— "frequency, orientation and spot function" of "HalftoneType 1".

An example of a "HalftoneType 3"-matrix used to produce halftone test charts is given in Annex J.

NOTE 1 This allows repeating the production at any time.

NOTE 2 Copiers often produce different output with test charts of identical colourimetric *L*a*b**-data but with a different halftone type.

1) Kodak Photo CD is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of this product.

4.4 Layout files and EPS-picture files (or equivalent)

Standard PS- and PDF-layout files (or equivalent) produce the A4-layout of the ISO-test charts. The standard layout files produce only the layout without any picture content.

At specific lines within a PS-layout file (or equivalent) the content of the pictures is included. The content is defined in "EPS-picture files" (or equivalent).

Each EPS-picture file (or equivalent) of test charts 1 and 3 produces only one picture different in size between 120 mm × 40 mm (A2, A4, A5, and A6), 120 mm × 84 mm (A1), 245 mm × 40 mm (A3) (see Figure 2).

Each EPS-picture file (or equivalent) of test charts 2 and 4 produces only one picture different in size between 130 mm × 86 mm (B1), 130 mm × 40 mm (B2 and B3), and 112 mm × 40 mm (B4, B5, B6 and B7) (see Figure 3).

The EPS-picture files (or equivalent) can be found as "technical information". The standard EPS-picture files produce the picture content located 25,4 mm in *x*- and *y*-direction from the left bottom corner of the output paper (see Annex M).

4.5 Digital PS-files and PDF-files (or equivalent) for ISO-test charts

Combined PS-files (or equivalent) include both the layout specification and the picture content. These PS-files (or equivalent) are called the "digital" ISO-test charts no. 1 to 4. They are shown in Figure 4 to Figure 7 reduced to half size.

NOTE The output of line rasters in pictures A5, A6, C5, and C6 is often different for PS- and PDF-files (or equivalent). ISO-test charts 1 and 3 show the reference output with line rasters.

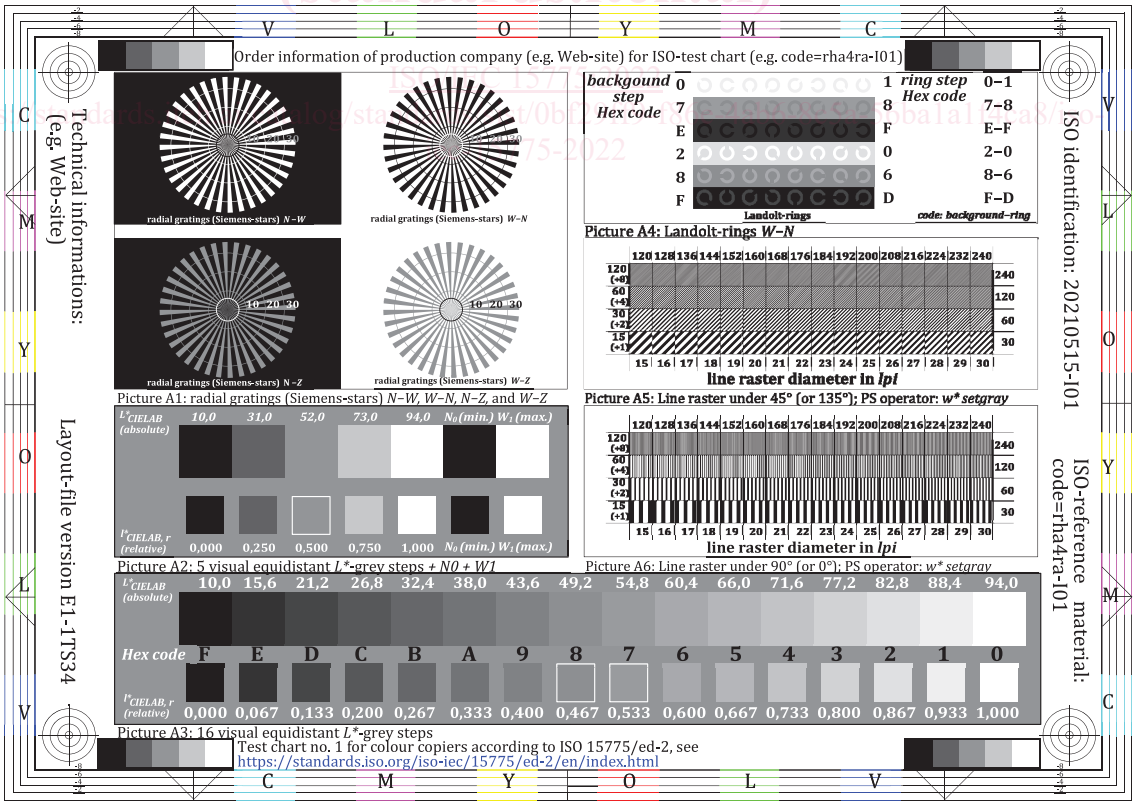

Figure 4 — PS-file (or equivalent) output of digital ISO-test chart 1 (reduced to half size)

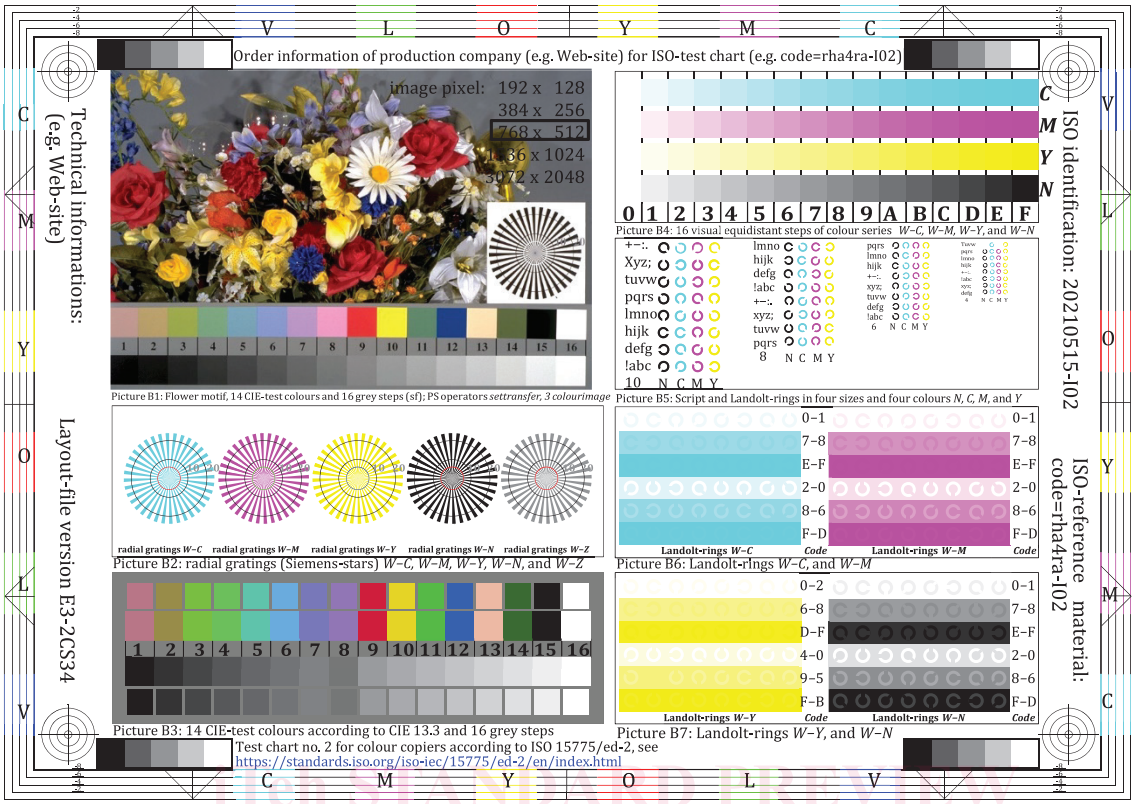

Figure 5 — PS-file (or equivalent) output of digital ISO-test chart 2 (reduced to half size)

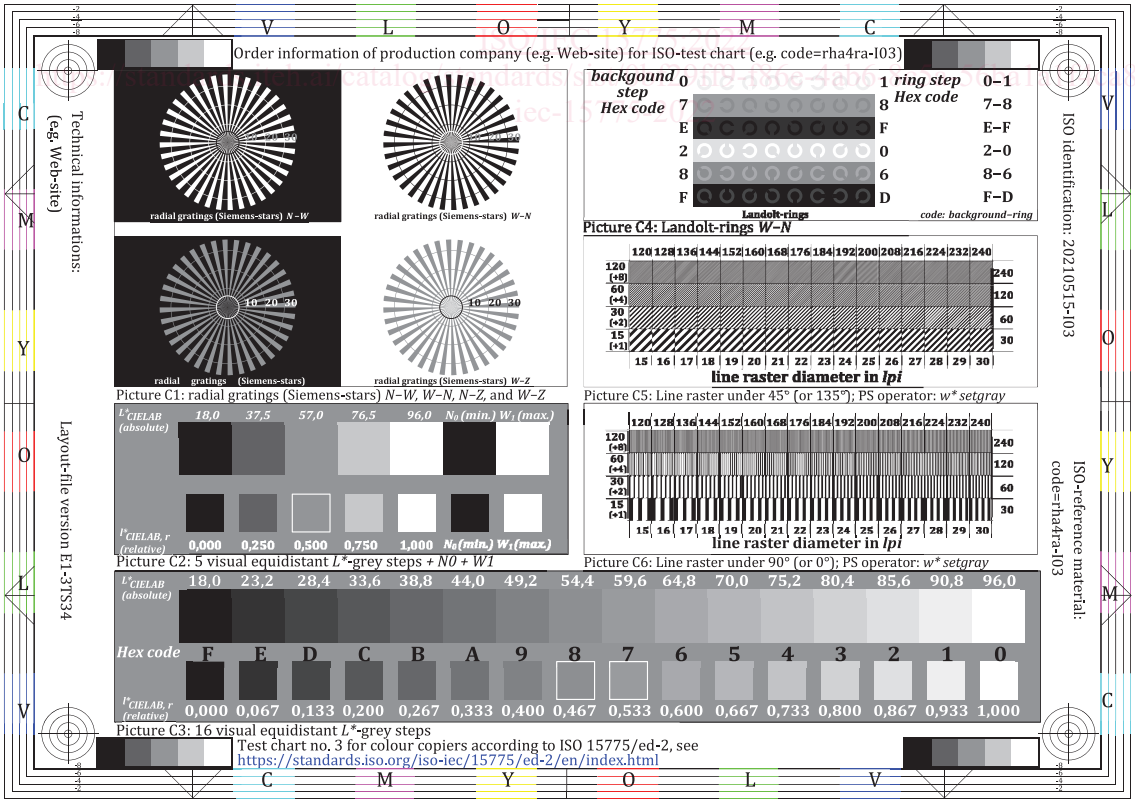

Figure 6 — PS-file (or equivalent) output of digital ISO-test chart 3 (reduced to half size)

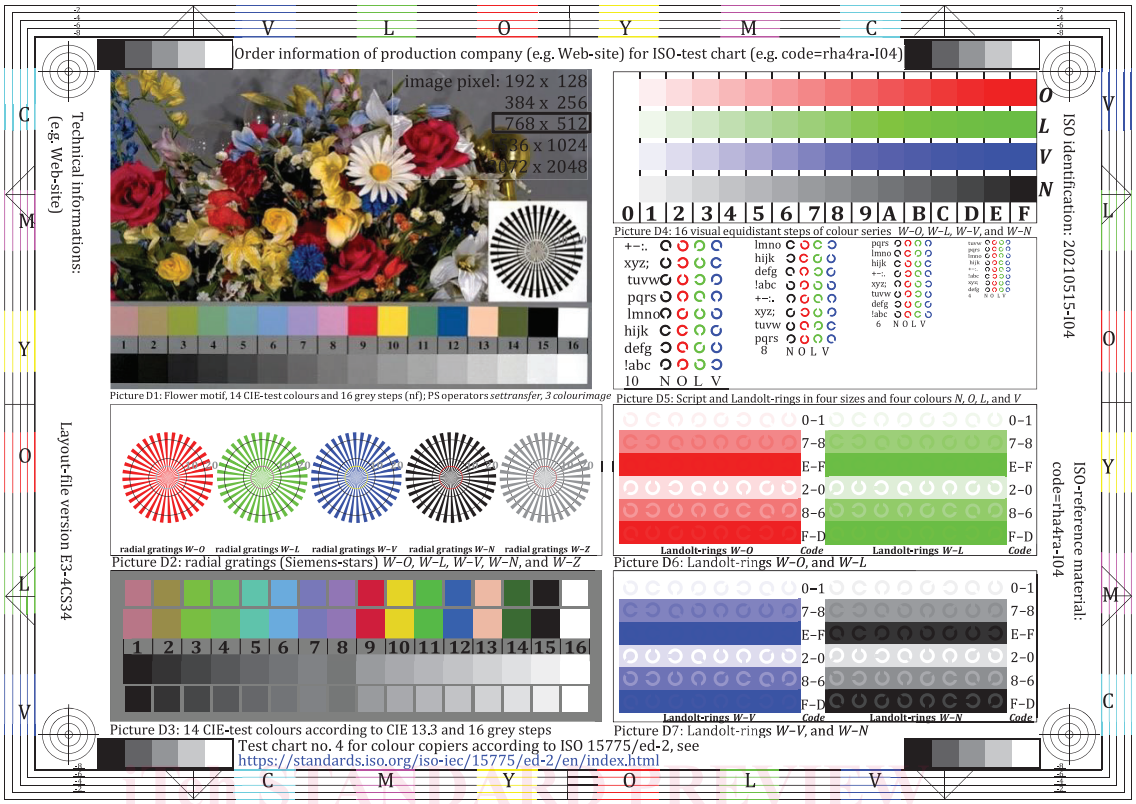

Figure 7 — PS-file (or equivalent) output of digital ISO-test chart 4 (reduced to half size)

The output of the digital standard PS-files (or equivalent) in the format A4 are shown separately on the ISO maintenance portal (see Annex M). Manufacturers of ISO-test charts will use these digital PS-files (or equivalent) as starting files for the production of analogue ISO-test charts 1 to 4.

Analogue test charts 1 to 4 are available in References [16] and [17].

The digital ISO-test charts include both the layout and the picture content including the colourimetric data of each test sample. Most of the intended colourimetric data can be found in Table 1 and Table 2, and in Annexes G and H. The colourimetric agreement of the produced colours of analogue test charts and the intended colours of digital test charts can be measured and evaluated by the method given in Annexes G and H.

4.6 Production of ISO-test charts

The production of the ISO-test charts by different manufacturers will show colourimetric differences. No colourimetric tolerance is given within this document for the manufacturers. The differences between intended and produced colours within the production of ISO-test charts 1 to 4 are given in Table 3 and Tables H.1 to H.11. Differences between intended and produced colours in these tables set an orientation tolerance for a possible ISO-colourimetric tolerance in the future.

All hard copy patterns (analogue test charts) produced according to this document should be discarded after three years. Due to time, temperature, and humidity, they change and therefore need replacement. Test charts should be kept in a sealed opaque container when not in use.

The usage of the produced ISO-test charts is limited for a three years' time beginning with the ISO identification date.