BS ISO/IEC 15775:2022

BSI Standards Publication

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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National foreword

This British Standard is the UK implementation of ISO/IEC 15775:2022.

The UK participation in its preparation was entrusted to Technical Committee IST/3, IT Printers and Cartridges.

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ISO/IEC 15775

Second edition
2022-12

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see https://patents.iec.ch).

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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.

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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.

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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

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

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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.

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

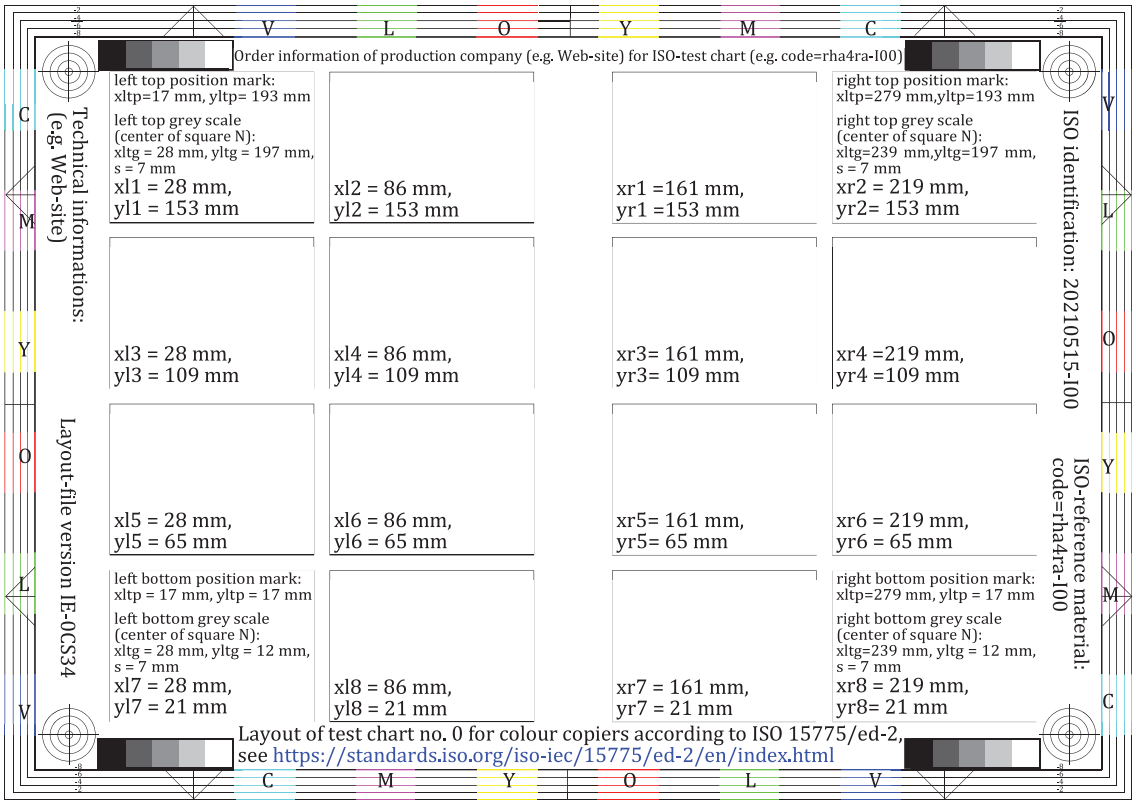

Figure 1 — Basic layout of the figures and the frame area around

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.

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

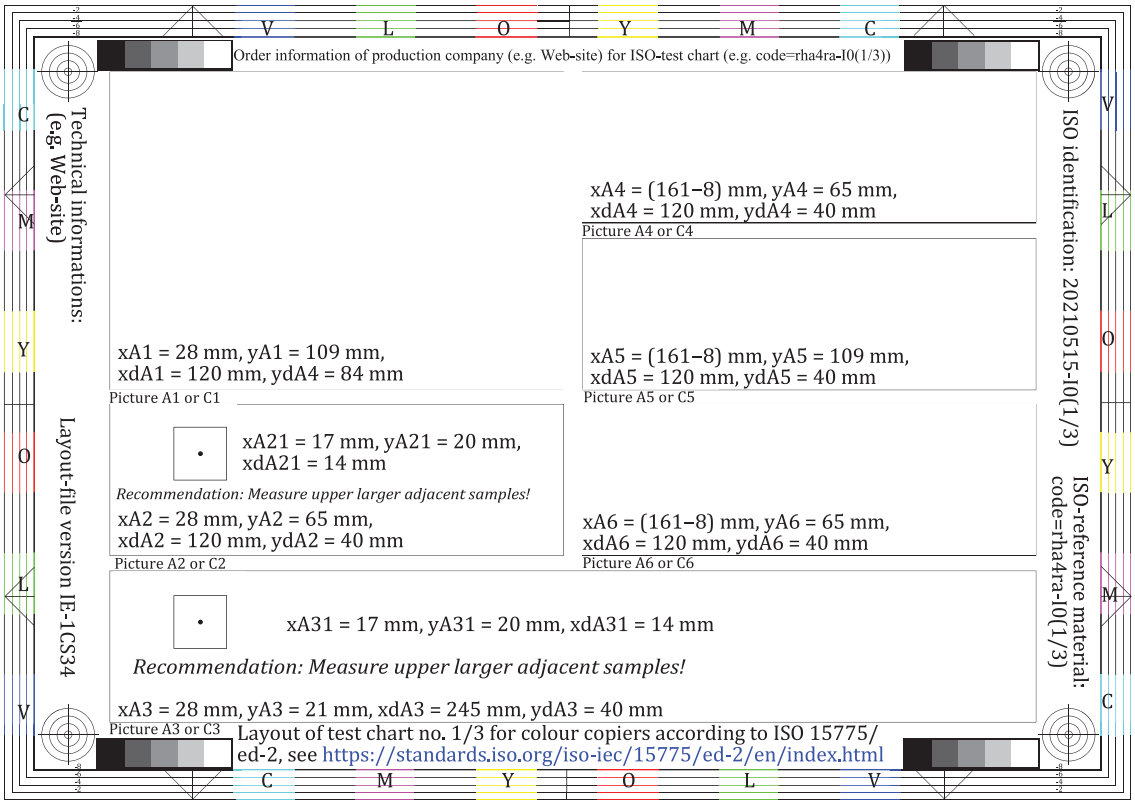

Figure 2 — Layout of picture and frame area of test charts 1 and 3

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.

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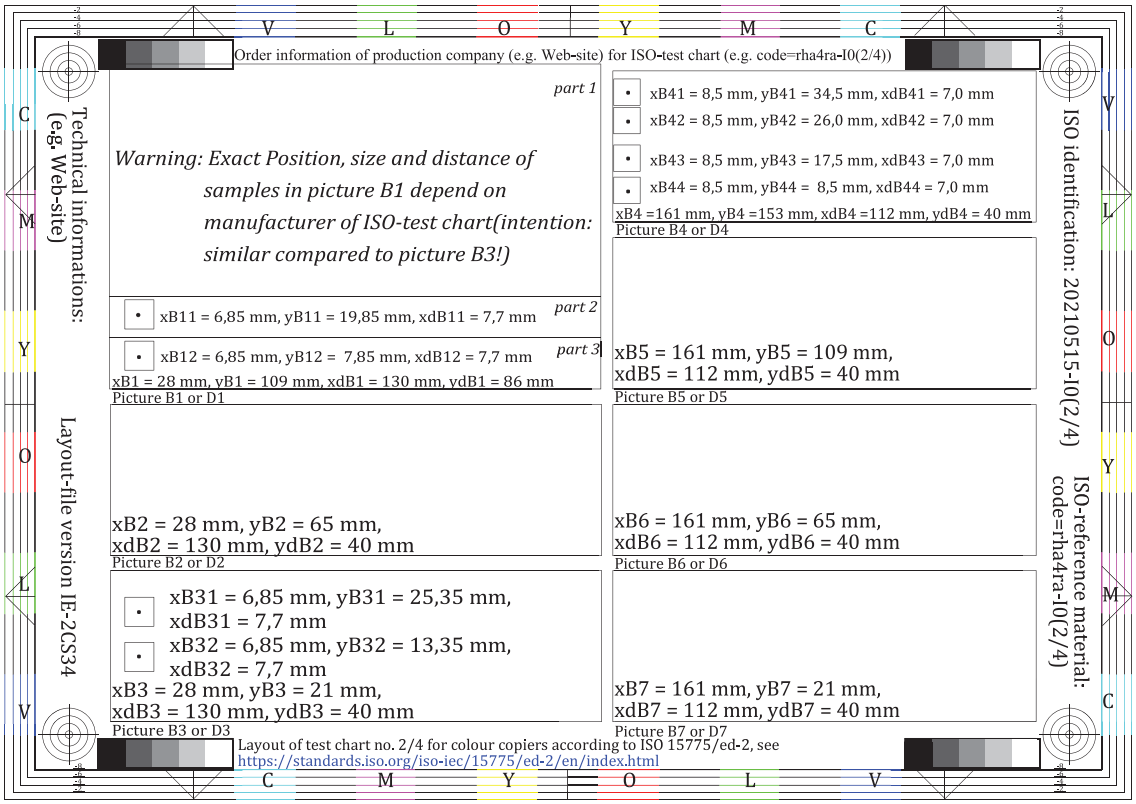

Figure 3 — Layout of picture and frame area of test charts 2 and 4

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);

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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.

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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.

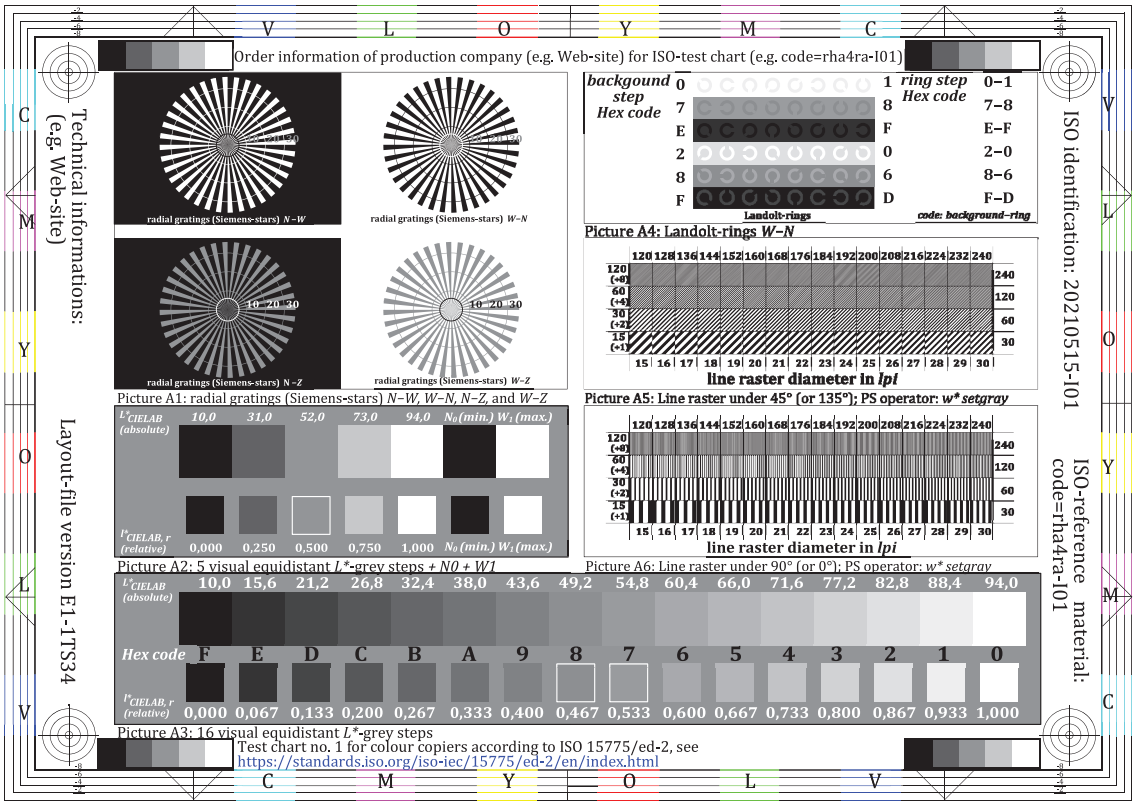

Figure 4 — PS-file (or equivalent) output of digital ISO-test chart 1 (reduced to half size)

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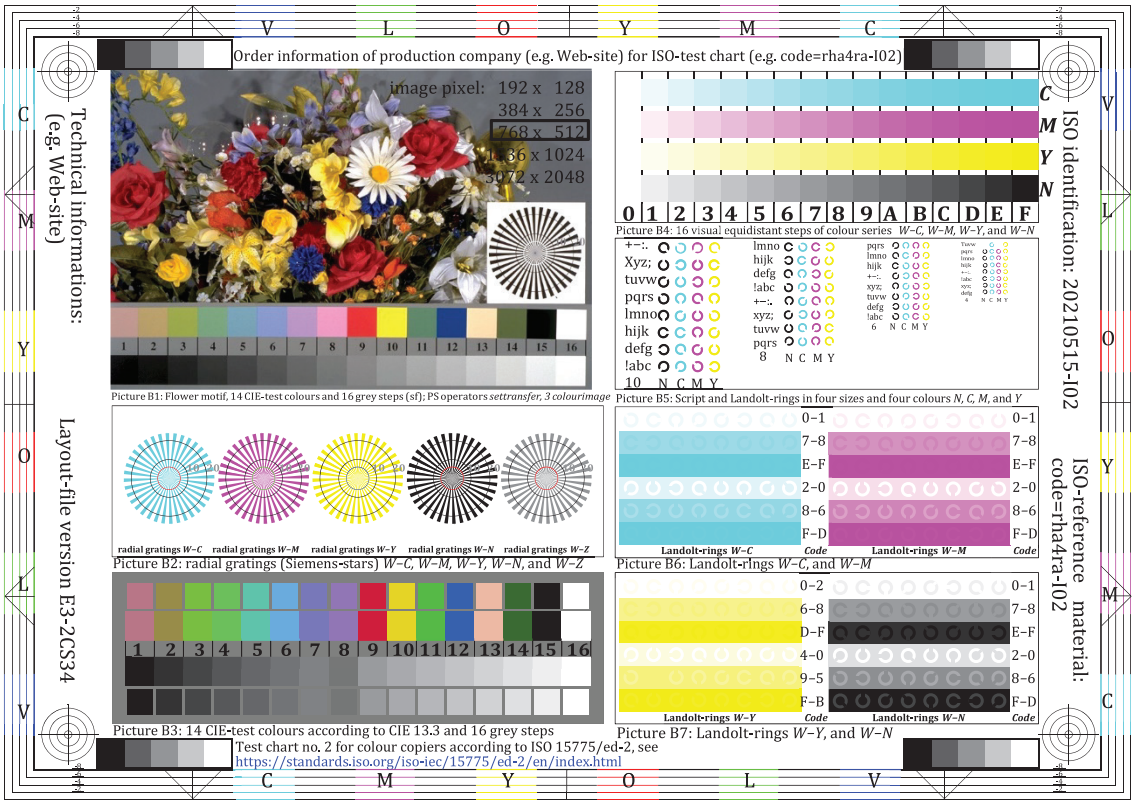

Figure 5 — PS-file (or equivalent) output of digital ISO-test chart 2 (reduced to half size)

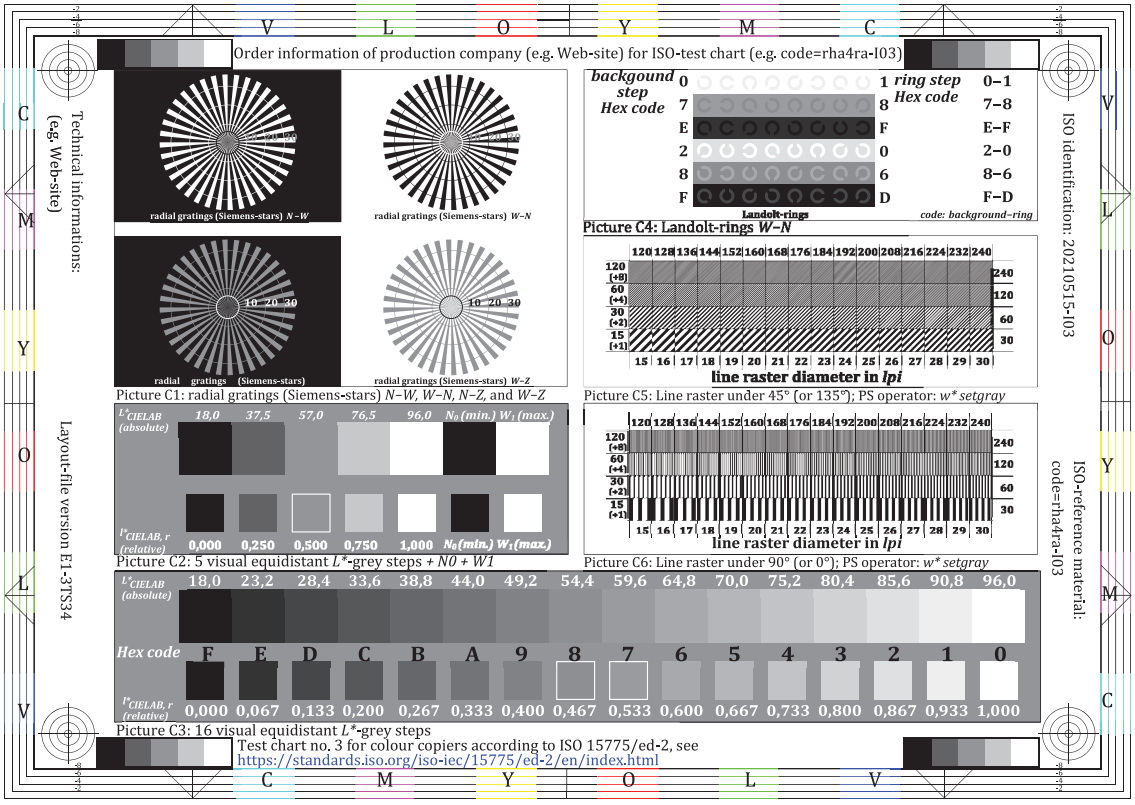

Figure 6 — PS-file (or equivalent) output of digital ISO-test chart 3 (reduced to half size)

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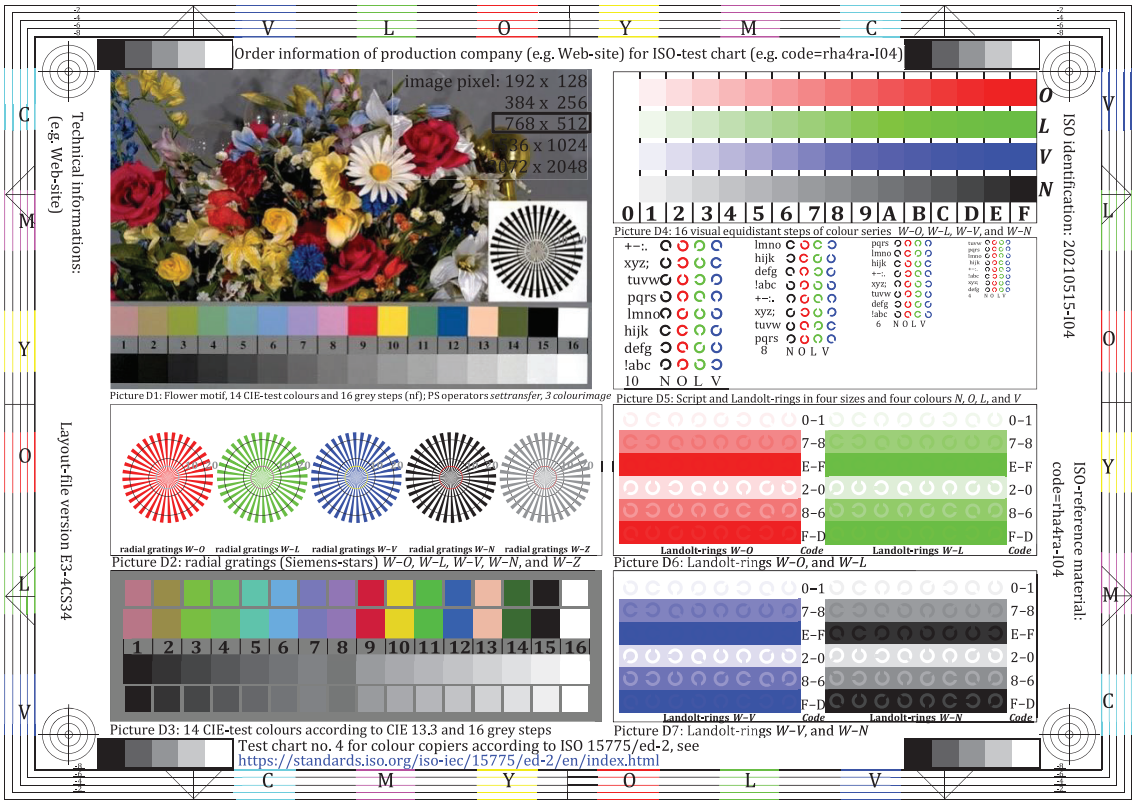

Figure 7 — PS-file (or equivalent) output of digital ISO-test chart 4 (reduced to half size)

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.

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4.7 Intended printing colours and comparison with produced colours

Table 1 — Intended printing colours CMYOLVNW and comparison with produced colours

Basic test colour name	Intended CIELAB data ISO 2846-1 (CMYNW) DIN 33866 series (OLV)			Produced CIELAB data DIN 33866 series (all) ITU-R BT.709-2 (all)			CIELAB differences of test colours Difference (o-r)			CIELAB test colour difference	
	L^*_r	a^*_r	b^*_r	L^*_o	a^*_o	b^*_o	$\Delta L^*_{o\text{-}r}$	$\Delta a^*_{o\text{-}r}$	$\Delta b^*_{o\text{-}r}$	$\Delta E^*_{o\text{-}r}$	
C	58,62	-30,62	-42,74	59,96	-27,80	-43,15	1,34	2,82	-0,41	3,15	2,55 (average $\Delta E^*_{ab,m}$)
M	48,13	75,2	-6,79	49,19	74,03	-7,40	1,06	-1,17	-0,61	1,69	
Y	90,37	-11,15	96,17	87,12	-5,58	105,61	-3,25	5,57	9,44	11,43	
O	47,94	65,31	52,07	47,94	65,31	52,07	0,00	0,00	0,00	0,00	
L	50,90	-62,96	36,71	50,90	-62,96	36,71	0,00	0,00	0,00	0,00	
V	25,72	31,45	-44,35	25,72	31,45	-44,35	0,00	0,00	0,00	0,00	
N	18,01	0,50	-0,46	17,16	-0,06	-2,71	-0,85	-0,56	-2,25	2,47	
W	95,41	-0,98	4,76	94,98	-0,58	3,28	-0,43	0,40	-1,48	1,59	
C	58,62	-30,62	-42,74	86,88	-46,17	-13,56	28,26	-15,55	29,18	43,50	31,33 (average $\Delta E^*_{ab,,m}$)
M	48,13	75,20	-6,79	57,30	94,35	-20,70	9,17	19,15	-13,91	25,38	
Y	90,37	-11,15	96,17	92,66	-20,70	90,75	2,29	-9,55	-5,42	11,22	
O	47,94	65,31	52,07 *(R)*	50,50	76,92	64,55	2,56	11,61	12,48	17,24	
L	50,90	-62,96	36,71 *(G)*	83,63	-82,76	79,90	32,73	-19,80	43,19	57,69	
V	25,72	31,45	-44,35 *(B)*	30,39	76,06	-103,59	4,67	44,61	-59,24	74,31	
N	18,01	0,50	-0,46	1,57	0,00	0,00	-16,44	-0,50	0,46	16,45	
W	95,41	-0,98	4,76	95,41	0,01	0,01	0,00	0,99	-4,75	4,85	

Table 1 shows intended colours *CMYOLVNW* compared to produced colours of the DIN 33866 series in the upper part. The intended colours are additionally compared with television colours according to ITU-R BT.709-2 in the lower part.

ISO 2846-1:2017, Table D.3 defines the intended colours of offset printing. Five colours $CMYNW_{PR}$ (PR = Print) are given for CIE-standard illuminant D65, the 2°-standard observer and the 45°/0°-standard geometry. Additionally, a nonfluorescent reference paper is described. The chromatic colours OLV_{PR} are not given.

The DIN 33866 series test charts 2 to 4 are produced on this ISO-reference paper *W* and with chromatic inks $CMYN_{PR}$ according to ISO 2846-1.

The colourimetric data *L*a*b** of reference (r = ISO 2846-1:2017, Table D.3) and the average colourimetric data of production (o = output) are given in the upper part of Table 1. The differences between reference and production (output) are small for the colours $CMYNW_{PR}$. The largest difference is ΔE^*_{ab} = 11,43 for yellow *Y* and the average difference is $\Delta E^*_{ab,m}$ = 2,55. Less than three units between pictural images cannot be detected by human viewers. Therefore, the colours *OLV* of production can be added up to get the colourimetric *L*a*b**-data for the full intended colour set $CMYOLVNW_{PR}$.

This document is used for colour copying machines and only the difference between copy and reference is of importance and not the absolute colourimetric *L*a*b**-data.

In the DIN 33866 series the short terms *OLV* are used for the colours OLV_{PR}. These short terms help to keep in mind that there are very large differences compared to the colours OLV_{TV} which are in standards usually called *RGB*. The short terms *RGB* used for colours on monitors conflict with the short terms *R*, *G*, and *B* for elementary colours (see Annex K).

In the lower part of Table 1 the printing colours are compared to the television colours defined in ITU-R BT.709-2 for CIE-standard illuminant D65 and the 2°-standard observer. The normalization to *L** =

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95,41 for white D65 as defined in ISO 2846-1 for white is used (see tables in DIN 33866-1). This part shows the differences between the colours $CMYOLVNW_{PR}$ and $CMYOLVNW_{TV}$. There are differences up to ΔE^*_{ab} = 74,31 for the colour violet blue *V* (called blue *B* in television) and the average difference is $\Delta E^*_{ab,m}$ = 31,33.

Table 2 — Reference and production of CIE-test colours

CIE test colour no,	Intended CIELAB data CIE 13.3 Reference (r)			Produced CIELAB data DIN 33866, Picture B6 Output (o)			CIELAB differences of test colours difference (o-r)			CIELAB-test colour difference
	L^*_r	a^*_r	b^*_r	L^*_o	a^*_o	b^*_o	ΔL^*_{o-r}	Δa^*_{o-r}	Δb^*_{o-r}	ΔE^*_{ab}
1	61,45	17,53	11,74	56,8	12,93	19,60	-4,65	-4,60	7,86	10,23
2	60,69	0,08	28,92	55,00	-2,42	35,85	-5,69	-2,50	6,93	9,31
3	62,02	-20,58	44,41	56,74	-24,61	42,51	-5,28	-4,03	-1,90	6,91
4	61,20	-33,16	17,07	60,90	-48,14	23,62	-0,30	-14,98	6,55	16,35
5	62,40	-17,47	-8,55	58,17	-19,98	-13,31	-4,23	-2,51	-4,76	6,84
6	61,51	-0,36	-28,39	57,44	0,10	-31,83	-4,07	0,46	-3,44	5,35
7	61,12	20,15	-24,55	56,85	18,29	-25,86	-4,27	-1,86	-1,31	4,84
8	62,77	27,42	-13,63	57,87	27,63	-21,75	-4,90	0,21	-8,12	9,49
9	39,92	58,74	27,99	41,87	38,70	33,27	1,95	-20,04	5,28	20,82
10	81,26	-2,89	71,56	75,56	4,20	74,01	-5,70	7,09	2,45	9,42
11	52,23	-42,42	13,6	47,15	-47,28	18,53	-5,08	-4,86	4,93	8,59
12	30,57	1,41	-46,47	34,8	1,37	-28,60	4,23	-0,04	17,87	18,36
13	80,23	11,37	21,04	77,59	15,62	29,57	-2,64	4,25	8,53	9,89
14	40,75	-13,80	24,23	36,07	-18,23	23,81	-4,68	-4,43	-0,42	6,46
Mean CIELAB colour difference: $\Delta E^*_{ab,m}$ = 10,2										

Table 2 shows intended CIE-test colours compared to produced CIE-test colours in DIN-test chart 2, picture B6. The mean CIELAB colour difference is $\Delta E^*_{ab,m}$ = 10,2. The largest colour differences occur for the CIE-test colours red (no. 9) and blue (no. 12) with ΔE^*_{ab} = 20,82 and 18,36 respectively.

The intended and produced colours may differ. The original test charts produced by different manufacturers may be different. Therefore, copies from a specific original should only be compared with each other or with the original which was used to produce the copies.

4.8 ISO-identification, ISO-reference material code, and ISO-image file version

Different ISO-codes are useful to manage, sort and distinguish the different ISO-test charts. Figures 1 to 7 include examples of the following codes:

— ISO-reference material code on the right bottom side;

— ISO-identification code on the right top side;

— ISO-image version code on the left bottom side;

The ISO-reference material code is described in the following Table 3.

Table 3 — ISO-reference material code and examples for colour copying machines

ISO-Reference materials for colour devices in different sizes and modes
1. Different sizes: A4, A6, 36 mm × 24 mm slide or negative film 2. Different tone techniques: continuous tone or halftone 3. Different modes: reflectance or transmittance mode 4. PS-program code (digital) or image to be viewed and measured (analogue)

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Table 3 *(continued)*

Colour device = Colour copying machine Example 1: Copy halftone test charts 2 to 3 and compare			
Test chart 1 ***N-photographic*** iha4ra = rha4ra oha4ra<>rha4ra	**Test chart 2** ***CMYN-offset*** iha4ra = rha4ra oha4ra<>rha4ra	**Test chart 3** ***N-offset*** iha4ra = rha4ra oha4ra<>rha4ra	**Test chart 4** ***OLVN-offset*** iha4ra = rha4ra oha4ra<>rha4ra
Example 2: Copy continuous tone test charts 1 to 2 and compare			
Test chart 1 ***N-photographic*** ica4ra = rca4ra oha4ra<>rca4ra	**Test chart 2** ***CMYN-photographic*** ica4ra = rca4ra oha4ra<>rca4ra	**Test chart 3** ***N-photographic*** ica4ra = rca4ra oha4ra<>rca4ra	**Test chart 4** ***OLVN-photographic*** ica4ra = rca4ra oha4ra<>rca4ra
Abbreviation at code-position: (<> compare ... with ...) Test chart for test mostly used: bold font, frequently used: italic font position no. 1: i=input; o=output; r=reference position no. 2: c=continuous tone; h=halftone position no. 3 and 4: a4=format A4; a6=A6, sf=slide or nf=negative film position no. 5: r=reflectance mode; t=transmittance mode position no. 6: a=analog mode; d=digital mode			

Table 3 shows the information for the ISO-reference material code and two examples for colour copying machines. In the lower part of Table 3 the abbreviations at code-positions 1 to 6 are given. Example codes for a colour copying machine with different test charts are given in the central part.

The ISO-identification code consists of the date (year, month, day), e.g. 19980615, the letter I (= ISO) and the ISO-test chart number (= 01 to 04). For more details see Annex I.

The date within the identification code should be the production date of the test pattern. This date helps to decide whether the ISO-test chart can be used or should be discarded after a three years' time beginning with the production date.

The ISO-image version code consists of the letter E (for E = English text), the digits 1 to 5 (for 5 different resolutions: 192 × 128 up to 3 072 × 2 048), the letter T (for text mode) or C (for colour mode), the letter S (for PostScript-format) or D (for PDF-format), and two digits for a version number. For more details see Annex I.

4.9 Content and purpose of frame area of the test charts

The ISO-test charts 1 to 4 contain a picture area and a frame area around. The frame area is very similar on all test charts and described here. The picture area is described in 4.10 separately for ISO-test charts 1 to 4.

In the frame area there are different text and image elements: text with codes for identification, rectangles, 5-step grey scales, and position marks.

NOTE 1 Some frame area specifications cannot work exactly if users place the test charts on the platen-glass inadequately.

Use of text with codes for identification:

Content:

The text in the frame region describes the ISO-test chart number, the ISO-identification code, the ISO-reference material code, the image file version of the test chart, and order information depending and defined by the manufacturer.

Purpose:

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The text is for identification of the ISO-test chart. To fill out forms E and F the following information is necessary: test chart text (bottom text), identification code, material code, and the image file version of test charts (see Annexes E and F).

Visual test:

There is no visual test of text in frame region.

Test of copied lines of rectangle:

NOTE 2 An ISO-reference test chart is in accordance with this document if there are at least complete lines for the inner (thicker line) rectangle. Therefore, there are between 4 lines and 20 lines on an ISO-test chart.

Content:

On the test charts there are up to five rectangles which are on each side 4 mm smaller. The outer rectangle is defined by the format A4 of the paper (297 mm × 210 mm).

Purpose:

The five frame rectangles help to detect visually how far the copying machine can copy.

Visual test:

In a visual test a yes or no decision shall be made how many lines are on the ISO-test chart and how many lines are copied.

Test of 5-step grey scales:

Content:

There are four equidistant grey scales near the four position marks (for exact position see "layout" 4.3.2).

NOTE 3 The grey samples in test charts 1 and 3 are equal to the 5-step samples of picture A2 or C2 respectively. There is no picture of 5-step grey scales in test charts 2 and 4 for direct comparison.

Purpose:

It is an agreement test of the four grey scales. Differences can be found by visual comparison of the four grey scales.

Visual test:

In an approximated test a yes or no decision shall be made if visual differences of the four grey scales can be clearly seen. If the four are different a decision shall indicate the most different grey scale compared to the average. A decision shall indicate the direction of deviation (darker or lighter) compared to the average.

Test of *x*- and *y*-scale factors by position marks:

Content:

The four position marks consist of circular rings (2 mm, 4 mm, 6 mm and 8 mm diameter) centred at crosses. They are located 17 mm in *x*- and *y*-direction from the corners of the format A4 (297 mm × 210 mm).

Purpose:

The position marks serve to measure the *x*- and *y*-scale factor of the copying machine.

Test: the difference of the position marks shall be measured in *x*- and *y*-direction in mm of both the original and the copy. The *x*- and *y*-scale factor shall be calculated.

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The ISO-reference difference of position marks is defined in PS-file (or equivalent) as 264 mm in *x*-direction and 176 mm in *y*-direction. For high accuracy of the two scale factors it is recommended to measure both the original and the copy with the same ruler.

NOTE 4 The position marks are often used to position colourimetric instruments for automatic *L*a*b** colourimetric measurements and to position the plates in four colour printing.

Test of shift of colour lines:

NOTE 5 Test charts are usually produced on colour material in colour mode (C). There are productions of test charts 1 and 3 completely in black and white text mode (T), e.g. ISO-test chart 1 on black and white photographic paper.

NOTE 6 If the test charts are completely in black and white text mode (T) the following test is obsolete. For completely black and white production the specification of "Test of shift of colour lines" can be omitted.

Content:

The lines defining the inner rectangles are drawn by different colours which alternate in colour between black and the colours *C, M, Y, O, L* and *V*.

Purpose:

The colours of the inner rectangle allow visually to decide if there are shifts of the colour lines *C, M, Y, O, L* and *V* compared to the black line in horizontal and vertical directions.

Visual test:

In an approximated test a Yes- or No- decision shall be made, if the shift of the colour *(C, M, Y, O, L, V)* lines compared to the black *N* line is larger or equal 0,2 mm (more than half of the linewidth defining the inner rectangle).

4.10 Content and purpose of picture area of the test charts

4.10.1 Test chart 1 (achromatic test chart: high lightness contrast)

Picture A1: radial gratings (Siemens-stars) *N–W, W–N, N–Z, W–Z*

Content:

It consists of radial gratings (Siemens-stars) in the combination of *N–W*, *W–N*, *N–Z*, *W–Z* with marked rings (6, 10, 20 and 30) mm in diameter.

Purpose:

It is a resolution test of colour copying machines. Differences can be found by comparison of the test chart with the reproduction of the pictures.

Visual test:

In a rough test, a yes or no decision shall be made if the diameter of the blurred area in the radial grating on the reproduction does not exceed the chosen ring size in all directions (yes or no decision).

For a detailed test the greatest diameter of the blurred area should be examined with an optical aid such as a magnifying glass-6x.

The rings with a diameter of (6, 10, 20 and 30) mm should be used as guidance.

NOTE 1 In some cases one cannot evaluate the inner area of the 6 mm ring. The blurred area of the original can be larger compared to the inner area of the 6 mm ring.

Picture A2 and A3: 5 or 16 visual equidistant *L-grey steps**

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Content:

Picture A2 contains five visually equidistant grey steps between white and black in two rows. A black N_0 and white W_1 is added. Picture A3 contains 16 equidistant grey steps also in two rows.

In the upper rows, the grey steps are adjacent, in the lower ones the grey steps are separated by the grey background.

For the sphere and medium picture content a medium grey with a lightness $L^* = 50 \pm 2$ was chosen for both fields (according to ISO 13655 a reflectance factor of 0,2 and respectively a luminance reflectance of $Y = 20$).

On the upper rows the lightness L^* of the CIELAB-colour system is stated above the individual grey steps. The grey steps of halftone ISO-test chart 1 are produced within the photographic process only from the colour black, and not from the four process colours *CMYN* because for the test chart the colour black cannot be produced with sufficient accuracy from these colours. The grey steps of the continuous ISO-test chart 1 are produced by the three process colours *CMY* of the photographic process.

NOTE 2 The theoretical values $L^* = 0$ and $L^* = 100$ for a black N_0 and white W_1 cannot be reached because there are no completely absorbing or reflecting surfaces. For black *(N)* and white *(W)* in the 5- and 16-step grey series the lightness values are described as L^*_N and L^*_W. In the halftone ISO-test chart 1 they are approximately 10 and 94 respectively. In the continuous tone ISO-test charts they are approximately 7 and 91 respectively. The mentioned numbers between 0,00 and 1,00 in the respective rows describe the relative lightness $l^*_{relative}$ between black and white for the relevant grey steps.

NOTE 3 $l^*_{relative}$ results of the CIELAB lightness L^*:

$$l^*_{relative} = (L^* - L^*_N) / (L^*_W - L^*_N) \quad (1)$$

Picture A3 shows the hexadecimal values above the individual grey steps of the lower rows.

NOTE 4 In printing technology, where paper white is taken as basis and the amount of black is described, the grey scale begins with white and the hexadecimal coding 0 and ends with black and the hexadecimal coding F.

Purpose:

The reproduction of pictures A2 respectively A3 are useful in deciding whether the device is capable of distinguishing the upper rows. If some greys of the upper rows look equal and cannot be separated then the lower rows are intended for an optional measurement.

NOTE 5 For many fields of application a distinction in five grey steps is sufficient, while a distinction of as many of the 16 grey steps as possible is desired for the reproduction of photographic pictures. The human being is capable of distinguishing about 200 grey steps between white and black positioned side by side.

Visual test:

It shall be judged how many of the five (picture A2) respectively 16 grey steps (picture A3) can be distinguished on the reproduction in the upper row.

Picture A4: Landolt-rings *N–W*

Content:

The picture contains 6 lines with 8 Landolt-rings each. For the Landolt-rings and the background (surround) different grey steps of the 16 grey steps of picture A3 have been selected.

NOTE 6 The values of the grey steps of the Landolt-rings and background correspond to the hexadecimal coding definition in picture A3.

Purpose:

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