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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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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

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

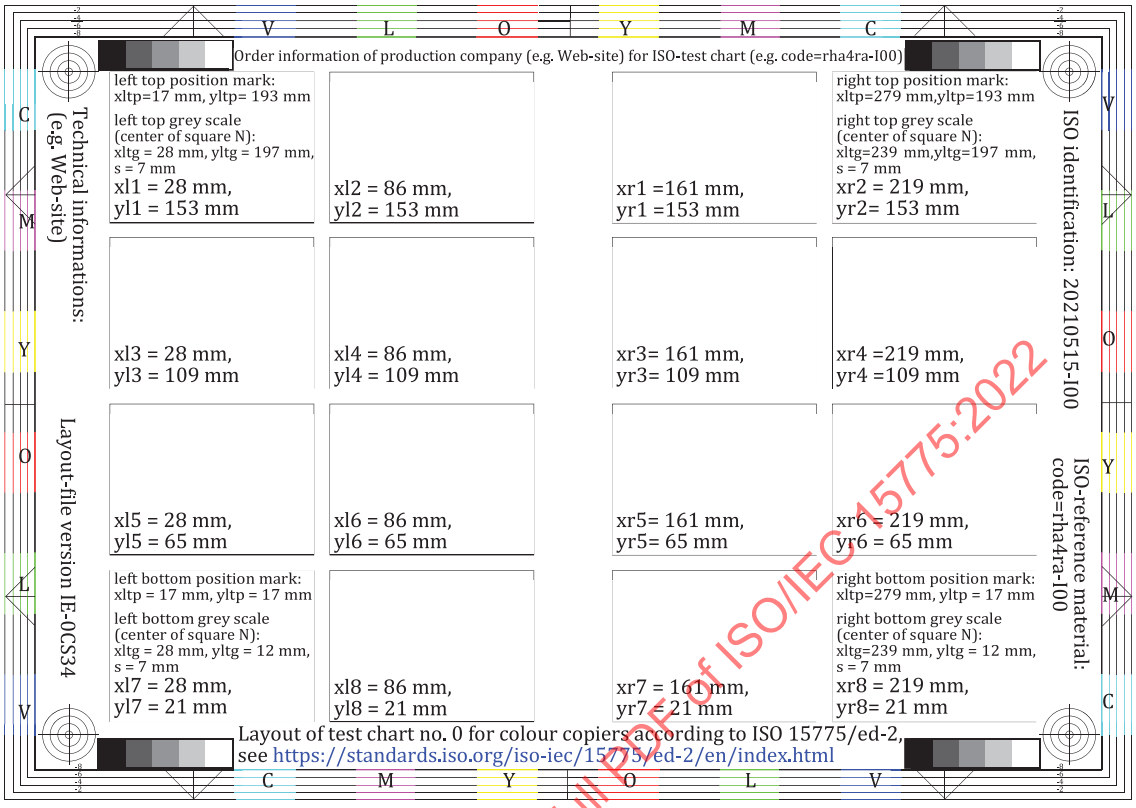

Figure 1 — Basic layout of the figures and the frame area around

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

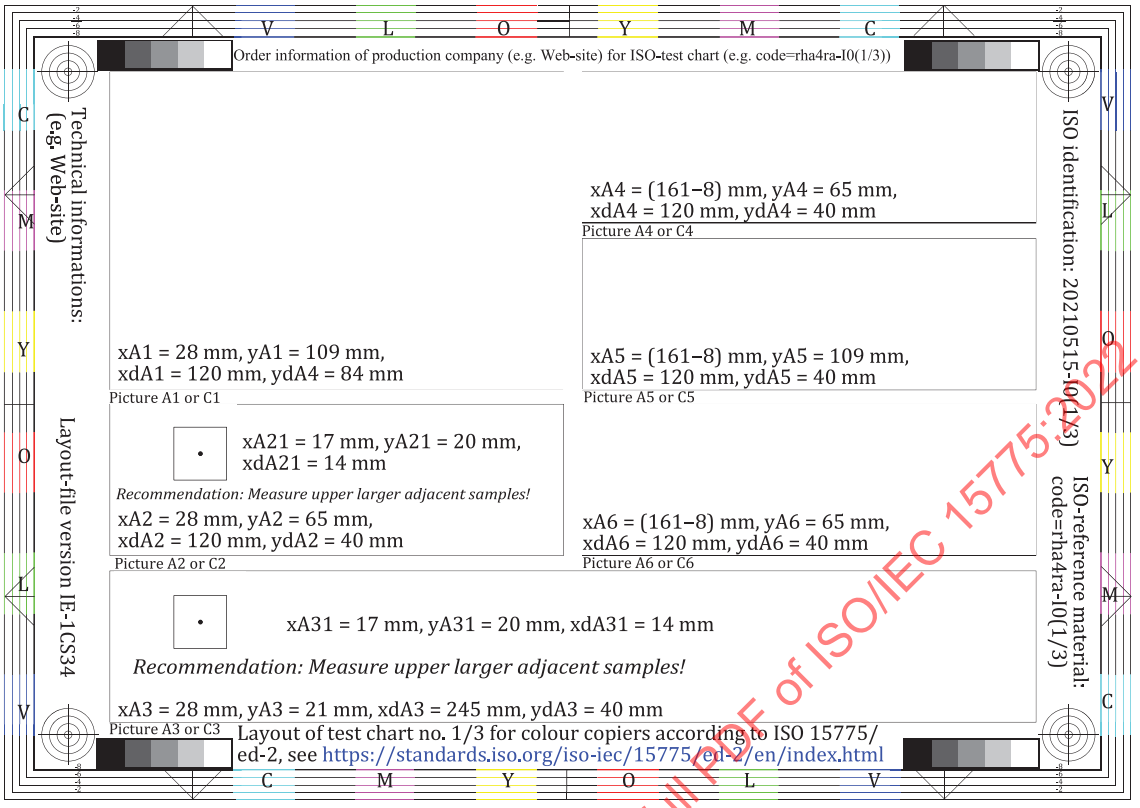

Figure 2 — Layout of picture and frame area of test charts 1 and 3

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.

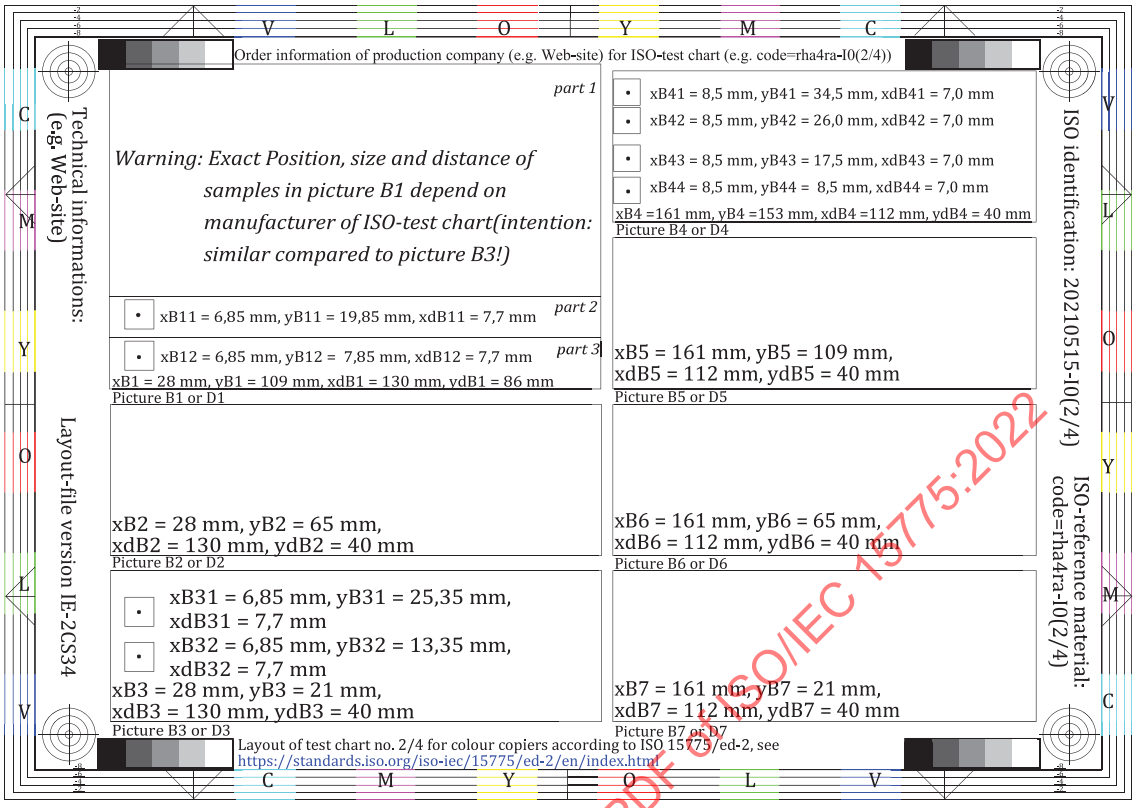

Figure 3 — Layout of picture and frame area of test charts 2 and 4

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.

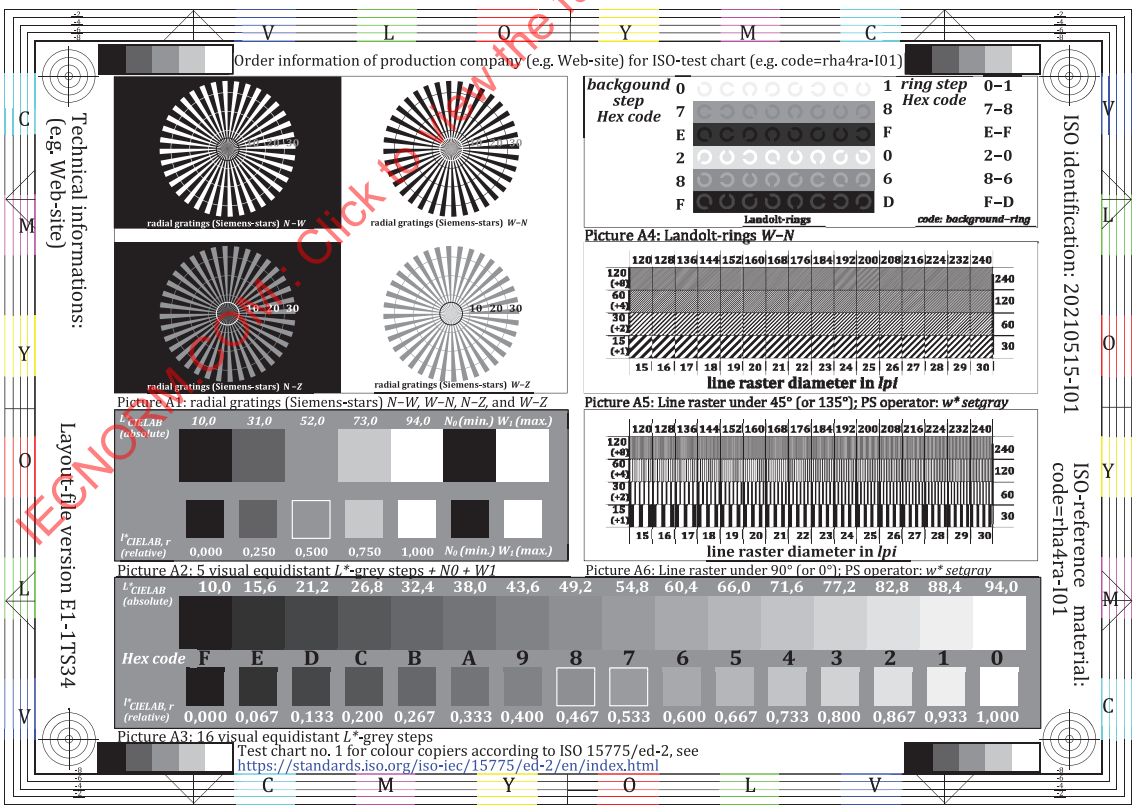

Figure 4 — PS-file (or equivalent) output of digital ISO-test chart 1 (reduced to half size)

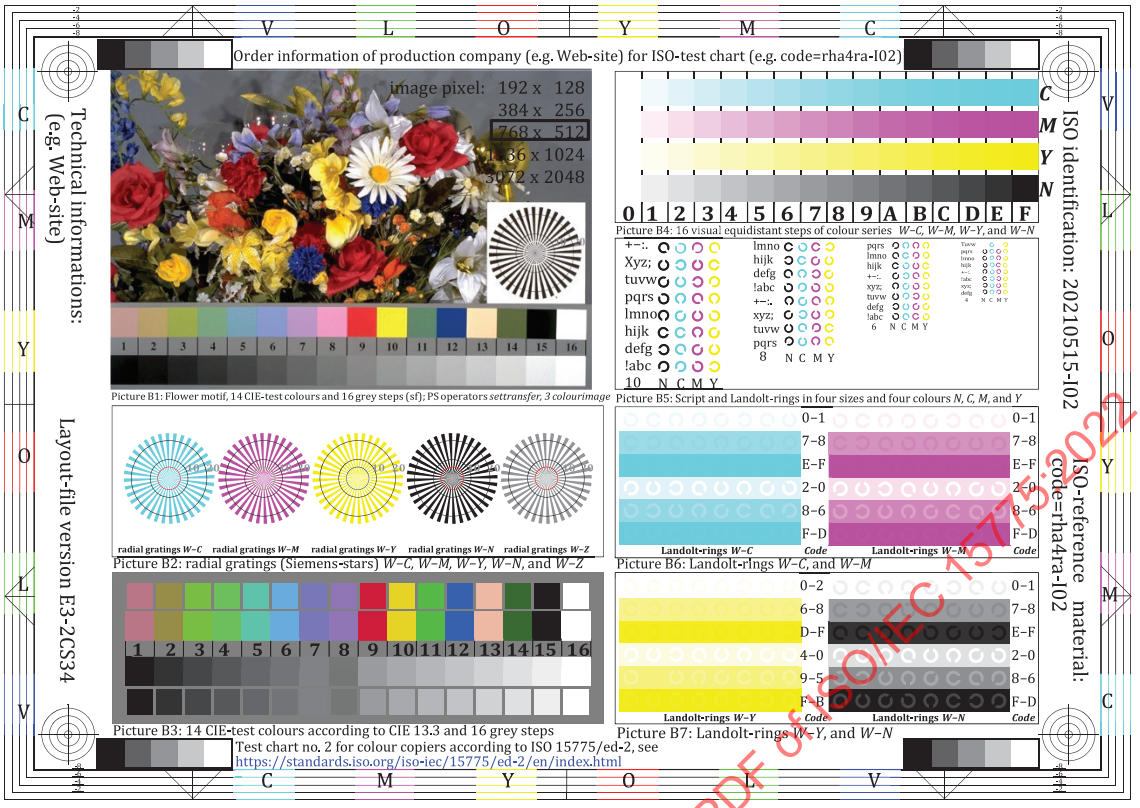

Figure 5 — PS-file (or equivalent) output of digital ISO-test chart 2 (reduced to half size)

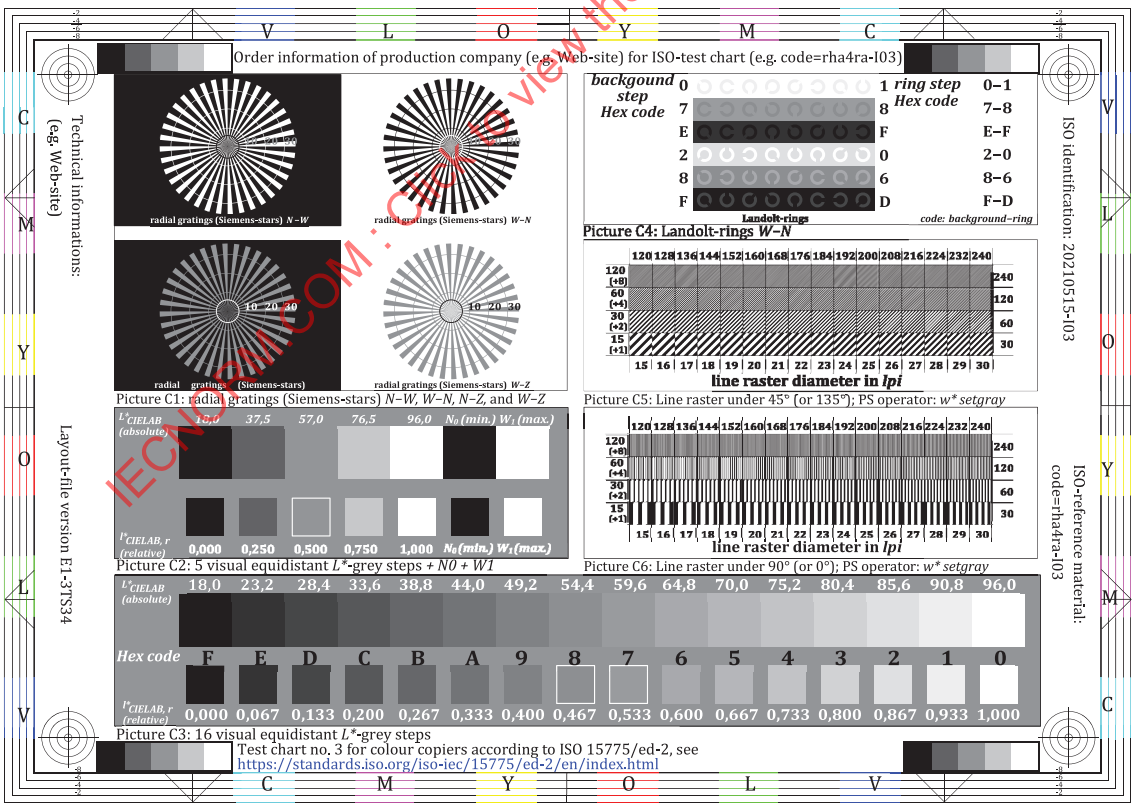

Figure 6 — PS-file (or equivalent) output of digital ISO-test chart 3 (reduced to half size)

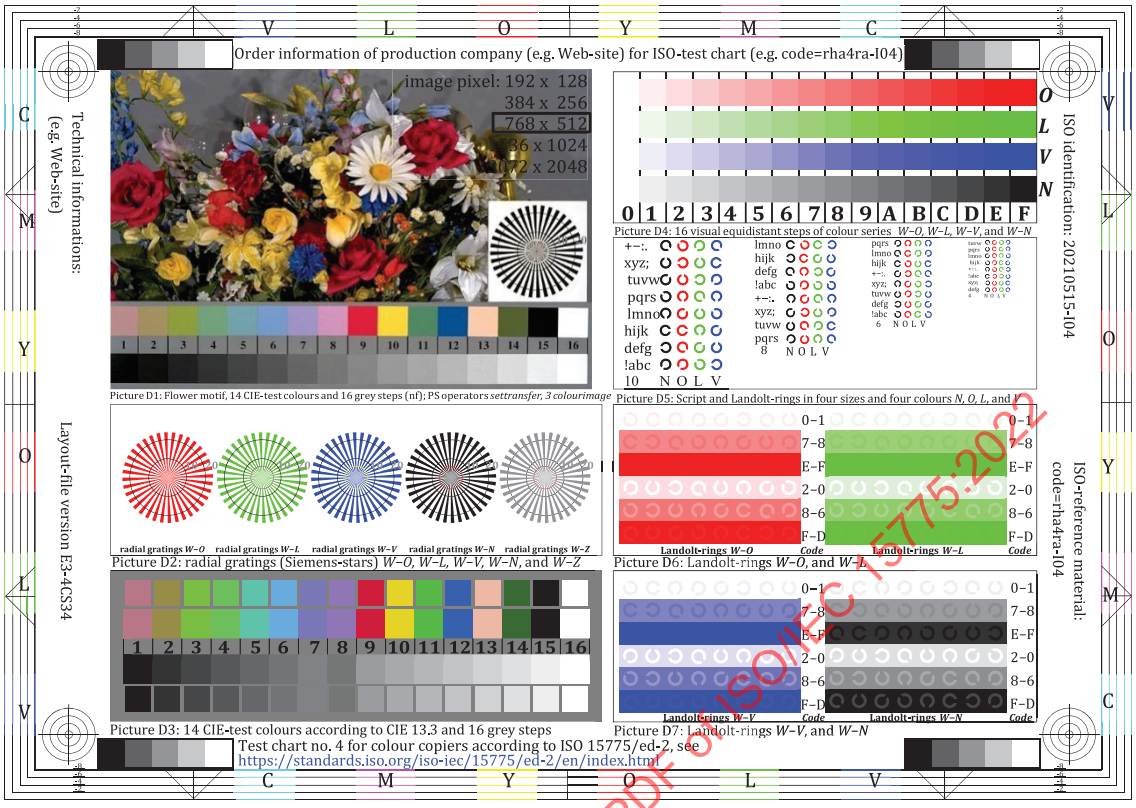

Figure 7 — PS-file (or equivalent) output of digital ISO-test chart 4 (reduced to half size)

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.

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** =

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)

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:

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.

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**

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:

The picture A4 allows a judgement concerning the reproduction in light, medium grey and dark areas. The differences between ring and background are in this area and in the upper three rows it is one grey step. In the lower three rows it is two grey steps.

Visual test:

The identification frequency of the Landolt-rings shall be judged by 5.2.3.

Pictures A5 and A6: different line raster diameter under 45° and 90°

Content:

The pictures contain line-elements with an angle of 45° (picture A5) respectively 90° (picture A6) and raster with diameter of (15 to 240) lines per inch (lpi).

NOTE 7 In the halftone ISO-test chart 1 240 lpi are produced. In continuous tone ISO-test chart 1 there is a technical limit of 75 lpi dependent on the 300 dots per inch (dpi) digital image setter used for production.

Purpose:

The pictures A5 and A6 serve to test the line reproduction.

Visual test:

By analogy with the interpretation of the Siemens-stars in picture A1, a rough examination shall be made with the naked eye to determine the highest spatial frequency which is perceptible.

For an exact examination an optical aid such as a magnifying glass-6x could be used to examine which raster unit diameter regular lines can be recognized.

NOTE 8 Colour copying machines have a fixed angle of scanning (normally horizontal or vertical). The reproductions correspond to the angles of the copied pattern whose marked pattern structures are shown, which are known in the printing area as Moiré-patterns and which will be lower by an angle of 45°. Because of this the test chart 1 contains pictures with two different angles.

NOTE 9 The line rasters diameter 80 lpi to 240 lpi can normally only be distinguished by using optical aids, such as a magnifying glass.

NOTE 10 In pictures A5 and A6 the one with the greatest lpi for which the lines and spaces can be distinguished is a measure of the copier resolution.

NOTE 11 It is possible that defects in copies made with the test patterns A5 and A6 for areas with greater than 60 lpi are not important.

It is recommended to rotate and move the test patterns A5 and A6 to different locations on the imaging platen as it can uncover additional reproduction defects.

4.10.2 Test chart 2 (chromatic test chart: CMYN colours)

Picture B1:

The content of this picture can be chosen by the manufacturer of the ISO-test charts. This content should include the 14 CIE-test colours plus N_0 and white W_1 and a 16-step grey scale. In the DIN 33866 series a flower image was chosen in test chart 2 and 14 CIE-test colours in ISO-test chart 4. The purpose of the flower image is described here as an example.

NOTE 1 Picture B1 is identical to picture D1 of test chart 4.

Picture B1: Flower image, 14 CIE-test colours plus black N_0 and white W_1, and 16-step grey scale

Content:

The flower image of the chromatic test chart represents the colours which are found in nature against a neutral grey background. This serves to judge the true reproduction of these colours. Furthermore,

the colours gold and silver have been included in the picture as metallic balls. The additional CIE-test colours plus black N_0 and white W_1, and 16-step grey scale may help to judge the fidelity of reproduction (see 4.3.5).

Purpose:

Picture B1 serves to compare colour fidelity of the test chart and its reproduction. The neutral grey background helps to recognize colour shifts. The mainly neutral grey background has various shadows.

NOTE 2 The test chart is not for judgement of individual preference colours and body tones, which can be judged differently in different countries.

NOTE 3 An optional radial grating (Siemens-star *N–W)* used in ISO-test chart 4 helps to get some information on pixel image resolution.

Visual test:

Clear (immediately conspicuous) differences between the original and the reproduction should be judged.

Picture B2: radial gratings (Siemens-stars) *W–C, W–M, W–Y, W–N* and *W–Z*

Content:

Radial gratings (Siemens-stars) in the combinations *W–C*, *W–M*, *W–Y*, *W–N* and *W–Z* with marked rings of (6, 10 and 20) mm in diameter.

Purpose:

Picture B2 serves for the judgement of resolution. The rings with a diameter of (6, 10 and 20) mm serve as guide.

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 and 20) mm should be used as guidance.

NOTE 4 In some cases the inner area of the 6 mm ring cannot be evaluated. The blurred area of the original can be larger compared to the inner area of the 6 mm ring.

NOTE 5 The lowest resolution is usually the one for the radial grating *W–Y* due to the low contrast between white and yellow.

Picture B3: 14 CIE-test colours, black N_0 and white W_1, 16 equidistant grey steps

NOTE 6 Picture B3 is identical to picture D3 of test chart 4.

Content:

In the upper two rows the picture contains 14 CIE-test colours according to CIE 13.3 and black N_0 and white W_1, in the lower row the picture contains 16 equidistant grey steps.

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

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

Purpose:

Picture B3 serves for the judgement of colour fidelity of the reproduction.

Visual test:

Clear (immediately conspicuous) differences of the 14 colours between the test chart and the reproduction are being judged (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

Clear (immediately conspicuous) differences of the 16 grey colours between the test chart and the reproduction are being judged (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

NOTE 7 The test colours reproduced in the test chart show small colour differences compared to the test colours defined in CIE 13.3. This fact can be ignored for the visual judgement as here the colour difference between the original and a copy is assessed.

Picture B4: 16 visual equidistant steps with the colours *W–C, W–M, W–Y* and *W–N*

Content:

The picture contains four rows with 16 colour steps each, using the colours *C, M, Y* and *N*, starting with white and the hexadecimal coding zero up to the colour with the hexadecimal coding F.

Purpose:

Picture B4 serves for the judgement of different colour steps.

Visual test:

For each of the four colours it should be examined visually, whether all 16 colour steps of the rows are different (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

NOTE 8 For a reproduction of photographic pictures the differentiation of as many of the 16 colour steps as possible of the individual colours is desired.

NOTE 9 In the *W–Y* row of the test chart 2 not all of the 16-steps can be distinguished by testing persons.

Picture B5: script and Landolt-rings in four sizes

Content:

The picture contains (in four groups with the relative sizes 10, 8, 6 and 4) 32 black characters and 8 Landolt-rings in the colours *N, C, M* and *Y* in each group.

Purpose:

Picture B5 serves for testing of reproduction by recognition of characters depending on their size and colour.

Visual test:

Each vertical line in every individual group should be judged if the frequency of recognition for the letters, Landolt-ring respectively is more than 50 % (see 5.2.3).

NOTE 10 For the decreasing relative sizes 10, 8, 6 and 4 the recognition is more difficult. It is possible that the Landolt-ring *Y* with size 10 of the original test chart is being recognized by some testers.

Picture B6 and B7: Landolt-rings *W–C, W–M, W–Y* and *W–N*

Content:

The pictures contain a block with six lines and eight Landolt-rings each for each of the four colours *C, M, Y* and *N*. For the Landolt-rings and the background different colour steps of the 16 colour steps of the corresponding colours in picture B4 have been selected in each case. They differ by one, respectively two, colour steps in the blocks *W–C*, *W–M* and *W–N* and by two, respectively four, colour steps in the block *W–Y*.

NOTE 11 The value of the colour steps of the Landolt-rings and the background corresponds to the hexadecimal value in picture B4.

Purpose:

Pictures B6 and B7 shall also allow a judgement of how the reproduction of characters on different backgrounds depends on the difference of the chromatic steps of characters and the background.

Visual test:

For tests the recognition frequency of the Landolt-rings shall be judged according to 5.2.3.

4.10.3 Test chart 3 (achromatic test chart: medium lightness contrast)

Picture C1: radial gratings (Siemens-stars) *N–W, W–N, N–Z, W–Z*

Content:

It contains 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 serves as 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 the inner area of the 6 mm ring cannot be evaluated. The blurred area of the original can be larger compared to the inner area of the 6 mm ring.

Picture C2 and C3: 5 or 16 visual equidistant *L-grey steps**

Content:

Picture C2 contains five visually equidistant grey steps between white and black in two rows. A black N_0 and white W_1 is added. Picture C3 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 photographical 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 3 are produced by three process colours *CMY* of the photographic process.

NOTE 2 The theoretical values L^* = 0 and L^* = 100 for 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 3 they are approximately 18 and 96 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^*:

$$l^*_{relative} = (L^* - L^*_N) / (L^*_W - L^*_N) \quad (2)$$

Picture C3 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 C2 respectively C3 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 C2) respectively 16 grey steps (picture C3) can be distinguished on the reproduction in the upper row.

Picture C4: Landolt-rings *N–W*

Content:

The picture contains six lines with eight Landolt-rings each. For the Landolt-rings and the background (surround) different grey steps of the 16 grey steps of picture C3 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 C3.

Purpose:

The picture C4 allows a judgement concerning the reproduction in light, medium grey and dark areas. The differences between ring and background are in this area and in the upper three rows it is one grey step. In the lower three rows it is two grey steps.

Visual test:

The identification frequency of the Landolt-rings shall be judged by 5.2.3.

Pictures C5 and C6: different line raster diameter under 45° and 90°

Content:

The pictures contain line-elements with an angle of 45° (picture C5) respectively 90° (picture C6) and raster with diameter of (15 to 240) lpi.

NOTE 7 In the halftone ISO-test chart 3 240 lpi are produced. In continuous tone ISO-test chart 3 there is a technical limit of 75 lpi dependent on the 300 dpi digital image setter used for production.

Purpose:

The pictures C5 and C6 serve to test the line reproduction.

Visual test:

By analogy with the interpretation of the Siemens-stars in picture C1, a rough examination shall be made with the naked eye to determine the highest spatial frequency which is perceptible.

For an exact examination an optical aid such as a magnifying glass-6x could be used to examine for which raster unit diameter regular lines can be recognized.

NOTE 8 Colour copying machines have a fixed angle of scanning (normally horizontal or vertical). The reproductions correspond to the angles of the copied pattern whose marked pattern structures are shown, which are known in the printing area as Moiré-patterns and which will be lower by an angle of 45°. Because of this the test chart 1 contains pictures with two different angles.

NOTE 9 The line rasters diameter 80 lpi to 240 lpi can normally only be distinguished by using optical aids, such as a magnifying glass.

NOTE 10 In pictures C5 and C6 the one with the greatest lpi for which the lines and spaces can be distinguished is a measure of the copier resolution.

NOTE 11 It is possible that defects in copies made with the test patterns C5 und C6 for areas with greater than 60 lpi are not important.

It is recommended to rotate and move the test patterns C5 and C6 to different locations on the imaging platen as it can uncover additional reproduction defects.

4.10.4 Test chart 4 (chromatic test chart: OLVN-colours)

Picture D1: the content of this picture can be chosen by the manufacturer of the ISO-test charts. This content should include the 14 CIE-test colours plus black N_0 and white W_1 and a 16-step grey scale. In the DIN 33866 series a flower image was chosen in test chart 2 and 14 CIE-test colours in ISO-test chart 4. The purpose of the flower image is described here as an example.

NOTE 1 Picture D1 is identical to picture B1 of test chart 2.

Picture D1: flower image, 14 CIE-test colours plus black N_0 and white W_1, and 16-step grey scale

Content:

The flower image of the chromatic test chart represents especially the colours which are found in nature against a neutral grey background. This serves to judge the true reproduction of these colours. Furthermore, the colours gold and silver have been included in the picture as metallic balls. The additional CIE-test colours plus black N_0 and white W_1, and the 16-step grey scale may help to judge the fidelity of reproduction (see 4.3.5).

Purpose:

Picture D1 serves to compare colour fidelity of the test chart and its reproduction. The neutral grey background helps to recognize colour shifts. The mainly neutral grey background has various shadows.

NOTE 2 The test chart is not for judgement of individual preference colours and body tones, which can be judged differently in different countries.

NOTE 3 An optional radial grating (Siemens-star *N–W)* used in ISO-test chart 4 helps to obtain information on pixel image resolution.

Visual test:

Clear (immediately conspicuous) differences between the original and the reproduction should be judged.

Picture D2: radial gratings (Siemens-stars) *W–O, W–L, W–V, W–N* and *W–Z*

Content:

It contains radial gratings (Siemens-stars) in the combinations *W–O*, *W–L*, *W–V*, *W–N* and *W–Z* with marked rings of (6, 10 and 20) mm in diameter.

Purpose:

Picture D2 serves for the judgement of resolution. The rings with a diameter of (6, 10 and 20) mm serve as guide.

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 and 20) mm should be used as guidance.

NOTE 4 In some cases the inner area of the 6 mm ring cannot be evaluated. The blurred area of the original can be larger compared to the inner area of the 6 mm ring.

Picture D3: 14 CIE-test colours, black N_0 and white W_1, 16 equidistant grey steps

NOTE 5 Picture D3 is identical to picture B3 of test chart 2.

Content:

In the upper two rows the picture contains 14 CIE-test colours according to CIE 13.3 and black N_0 and white W_1, in the lower row the picture contains 16 equidistant grey steps.

In the upper rows, the colours and grey steps are right adjacent, in the lower ones the colours and 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 $Y = 20$).

Purpose:

Picture D3 serves for the judgement of colour fidelity of the reproduction.

Visual test:

Clear (immediately conspicuous) differences of the 14 colours between the test chart and the reproduction are being judged (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

Clear (immediately conspicuous) differences of the 16 grey colours between the test chart and the reproduction are being judged (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

NOTE 6 The test colours reproduced in the test chart show small colour differences compared to the test colours defined in CIE 13.3. This fact can be ignored for the visual judgement as here the colour difference between the original and the copy is assessed.

Picture D4: 16 visual equidistant steps with the colours *W–O, W–L, W–V* and *W–N*

Content:

The picture contains three rows with 16 colour steps each, using the colours *O, L, V* and *N*, starting with white and the hexadecimal coding zero up to the colour with the hexadecimal coding F.

Purpose:

Picture D4 serves for the judgement of different colour steps.

Visual test:

For each of the four colours it should be examined visually, whether all 16 colour steps of the rows are different (yes or no decision). Should this not be the case, the number of distinguishable steps should be stated.

NOTE 7 For a reproduction of photographic pictures the differentiation of as many of the 16 colour steps as possible of the individual colours is desired.

Picture D5: script and Landolt-rings in four sizes

Content:

The picture contains (in four groups with the relative sizes 10, 8, 6 and 4) 32 black characters and 8 Landolt-rings in the colours *N, O, L,* and *V* and in each group.

Purpose:

Picture D5 serves for testing of reproduction by recognition of characters depending on their size and colour.

Visual test:

Each vertical line in every individual group should be judged if the frequency of recognition for the letters, Landolt-ring respectively is more than 50 % (see 5.2.3).

NOTE 8 For the decreasing relative sizes 10, 8, 6 and 4 the recognition is more difficult.

Picture D6 and D7: Landolt-rings *W–O, W–L, W–V* and *W–N*

Content:

The pictures contain a block with six lines and eight Landolt-rings each for each of the four colours *O, L, V* and *N*. For the Landolt-rings and the background different colour steps of the 16 colour steps of the corresponding colours in picture D4 have been selected in each case. They differ by one, respectively two, colour steps in the blocks *W–O*, *W–L*, *W–V* and *W–N*.

NOTE 9 The value of the colour steps of the Landolt-rings and the background corresponds to the hexadecimal value in picture D4.

Purpose:

Pictures D6 and D7 shall also allow a judgement of how the reproduction of characters on different backgrounds depends on the difference of the chromatic steps of characters and the background.

Visual test:

For tests the recognition frequency of the Landolt-rings shall be judged according to 5.2.3.

5 Tests

5.1 General

The tests according to this document shall be made on a set of two copies of one achromatic and one chromatic ISO-test chart with a reproduction scale of 1:1. These copies shall be made from the test charts 1, 2, 3 and 4 in series by unchanged adjustments of the colour copying machine.

One achromatic test chart (1 or 3) and one chromatic (2 or 4) either both halftone type or continuous tone type shall be used.

Operating conditions such as media and attachments (paper; colour inks) given by individual manufacturers of colour copying machines shall be met. The copies shall be tested immediately after production. Two procedures are available for testing:

— visual test, if necessary, with optical aid such as a magnifying glass-6x;

— colourimetric specification (for interpretation see Annex G).

For the summary of the results, the forms in Annexes A, B, C and D shall be used for the visual evaluation of the reproduction of the test charts 1 to 4. The pictures of these test charts are numbered A1 - A6, B1 - B7, etc. and assigned to the individual pictures of the test charts (see 4.10).

Annexes E and F shall be used for writing down text and codes of the frame area of ISO-test charts and for visual tests of line, 5-step grey scale, and scale factor reproduction (see 4.9).

5.2 Visual test

5.2.1 General

The visual test has been already described in 4.9 and 4.10 in conjunction with the definition of the individual pictures on the test charts.

5.2.2 Testing conditions

The following conditions shall be met when testing:

— viewing conditions P2 for practical appraisal of prints in ISO 3664 shall be used;

— observation of the 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.

The testing persons shall have normal colour vision and visual acuity.

Test “Measure colour vision and visual acuity using any of available standard tests”.

— For testing normal colour vision the colour vision deficiencies may be tested (for example, with an “Anomaloscop” according to DIN 6160 or equivalent).

— The visual acuity (also with seeing aid) shall be checked (for example according to DIN 58220-5 or equivalent).

5.2.3 Recognition frequency for use of Landolt-rings

The eight rings of the Landolt-ring groups in the different pictures represent the different orientations of the Landolt- rings according to ISO 8596. Test criteria for the visual evaluation of each group is the recognition frequency of the Landolt- rings.

The recognition frequency of at least 5 of 8 rings is above 50 %.

5.3 Colourimetric specification

5.3.1 General

A colourimetric specification includes data for (see Annex G):

— regularity g^*;

— lightness gamut f^*;

— mean lightness difference ΔL^*_{m};

— mean colour difference $\Delta E^*_{ab,m}$;

— mean colour reproduction index $R^*_{ab,m}$.

5.3.2 Colourimeter

The colourimeter shall permit the determination of the CIELAB colourimetric parameters L^*, a^*, b^* (or of the colourimetric tristimulus values X, Y and Z) according to ISO 13655 for the CIE-2°- standard observer, the illuminant D50 as default, D65, F11 and A as optional, and the CIE-standard geometry 45°/0°.

NOTE Currently most of the office equipment manufactures adopted illuminant D50. Colourimetric result between D50 and D65 is below ΔE^*_{ab} of one which is below the visual threshold.

5.3.3 Calculation method

The calculation methods of CIEXYZ and CIELAB are described in ISO 13655.

5.3.4 Measurements

Measurement condition M1 specified in ISO 13655 shall be used. Measurement condition M2 and M3 specified in ISO 13655 are optional. When another measurement condition other than default is used, the measurement condition shall be reported together with the presentation of the results of measurements.

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.

On the copy and the test chart the lightness L^* of the five achromatic test colours of pictures A2 (or C2) and the 14 chromatic CIE-test colours of picture B6 (or D6) as well as the chromaticness a^* and b^* of these colour surfaces shall be measured.

It is recommended to measure both the ISO-test chart and the copy with the same instrument. A PS-file (or equivalent) (see Table G.2) can be used to include the measured data by any editor. Any PS-interpreter (or equivalent) will produce a formatted table similar to Table G.2.

NOTE Measured data of other colour series can be used to get similar tables shown in Annex H for all colour series of the DIN-test charts.

5.3.5 Evaluation

According to Annex G for each colourimetric parameter the procedures for calculation resulting from the colourimetric measurement data are described together with an example.

6 Test report

The test report shall contain at least the following:

— statement of the colour copying machine model;

— selected copying mode and/or specification of the selected adjustment;

WARNING — Results with monochrome test pattern may depend on colour copier mode of operation or setting, for example whether auto text, auto black and white mode, or full colour mode is chosen.

— description of copying paper used;

— description of other materials used;

— testing method;

— four forms filled out for the visual interpretation of the reproduction of test charts 1, 2, 3 and 4 for colour copying machines according to this document (Annexes A or C and E, and B or D and F);

— the normal colour visual acuity and normal visual acuity of the testing persons according to 5.2.2 shall be stated.

Annex A
(normative)

Form A

Form A serves as the visual interpretation of the ISO-test chart 1 reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Test of the radial grating according to picture A1

N–W-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
W–N-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
N–Z-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
W–Z-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm

Test of 5 visual equidistant *L-grey steps according to picture A2**

Are the 5-steps on the upper rows distinguishable?	Yes/No
If No: How many steps can be distinguished?	of the given 5 steps: .....Steps

Test of 16 visual equidistant *L-grey steps according to picture A3**

Are the steps on the upper rows distinguishable?	Yes/No
If No: How many steps can be distinguished?	of the given 16 steps: .....Steps

Test of the Landolt-rings *N–W* according to picture A4

Is the recognition frequency of the Landolt-rings > 50% (5 of 8 at least)?

background — ring	
0 — 1	Yes/No
7 — 8	Yes/No
E — F	Yes/No
2 — 0	Yes/No
8 — 6	Yes/No
F — D	Yes/No

Test of the line screen under 45° according to picture A5

Can equally spaced lines be seen?		
Visual testing: for lines from (15 to 60) lpi		Yes/No
Test with a magnifying glass (e.g. 6x):	- from 15 lpi:	to ..... lpi

Test of the line screen under 90° according to picture A6

Can equally spaced lines be seen?		
Visual testing: for lines from (15 to 60) lpi		Yes/No
Test with a magnifying glass (e.g. 6x):	- from 15 lpi:	to ..... lpi

Annex B
(normative)

Form B

Form B serves as the visual interpretation of the ISO-test chart 2 reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Test of the (flower) image according to picture B1
Are there clear (immediately conspicuous) differences between reproduction and test chart? Yes/No
Subjective remarks about the colour reproduction of the (flower) image, the CIE-test colours and the 16 grey steps:
.....
.....
.....

Test of the resolution in the radial gratings *W–C, W–M, W–Y, W–N* and *W–Z* according to picture B2

	W–C	***W–M***	***W–Y***	***W–N***	***W–Z***
Visual testing: Is the resolution diameter < 6 mm?	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Test with magnifying glass: Resolution diameter	..... mm	.....mm	.....mm	.....mm	.....mm

Test of the 14 CIE-test colours according to picture B3
Are clear (immediately conspicuous) differences recognized between reproduction and test chart? Yes/No
If Yes: How many colours have clear differences? of the given 14 colours: .....Colours

Test of 16 visual equidistant L* -grey steps according to picture B3
Are the steps on the upper rows distinguishable? Yes/No
If No: How many steps can be distinguished of the given 16 steps: .....Steps

Test of 16 visual equidistant steps of the colour rows *W–C, W–M, W–Y* and *W–N* according to picture B4
W–C White—Cyanblue: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–M White—Magentared: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–Y White—Yellow: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–N White—Black: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps

Test of characters and Landolt-rings in four sizes according to picture B5
Is the recognition frequency >50% for letters (17 from 32 at least) and for Landolt-rings (min. 5 of 8)?

Relative size	Letters	Rings ***N***	Rings ***C***	Rings ***M***	Rings***Y***
10	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
8	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
6	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
4	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Test of the recognition frequency of the Landolt-rings W–C, W–M, W–Y and W–N according to pictures B6 and B7
Is the recognition frequency of the Landolt-rings >50% (min. 5 of 8 at least)?

Colour rows***W–C***	Colour rows ***W–M***	Colour rows ***W–Y***	Colour rows ***W–N***
background — ring	background — ring	background — ring	background — ring
0 — 1 Yes/No	0 — 1 Yes/No	0 — 2 Yes/No	0 — 1 Yes/No
7 — 8 Yes/No	7 — 8 Yes/No	6 — 8 Yes/No	7 — 8 Yes/No
E — F Yes/No	E — F Yes/No	D — F Yes/No	E — F Yes/No
2 — 0 Yes/No	2 — 0 Yes/No	4 — 0 Yes/No	2 — 0 Yes/No
8 — 6 Yes/No	8 — 6 Yes/No	9 — 5 Yes/No	8 — 6 Yes/No
F — D Yes/No	F — D Yes/No	F — B Yes/No	F — D Yes/No

Annex C
(normative)

Form C

Form C serves as the visual interpretation of the ISO-test chart 3 reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Test of the radial grating according to picture C1

N–W-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
W–N-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
N–Z-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm
W–Z-radial grating:	Is the resolution diameter < 6 mm?	Yes/No
	Test with magnifying glass (e.g. 6x)	resolution diameter: .....mm

Test of 5 visual equidistant *L-grey steps according to picture C2**

Are the 5-steps on the upper rows distinguishable?	Yes/No
If No: How many steps can be distinguished?	of the given 5 steps: .....Steps

Test of 16 visual equidistant *L-grey steps according to picture C3**

Are the steps on the upper rows distinguishable?	Yes/No
If No: How many steps can be distinguished?	of the given 16 steps: .....Steps

Test of the Landolt-rings *N–W* according to picture C4

Is the recognition frequency of the Landolt-rings > 50% (5 of 8 at least)?

background — ring	
0 — 1	Yes/No
7 — 8	Yes/No
E — F	Yes/No
2 — 0	Yes/No
8 — 6	Yes/No
F — D	Yes/No

Test of the line screen under 45° according to picture C5

Can equally spaced lines be seen?

Visual testing: for lines from (15 to 60) lpi		Yes/No
Test with a magnifying glass (e.g. 6x):	- from 15 lpi:	to ..... lpi

Test of the line screen under 90° according to picture C6

Can equally spaced lines be seen?

Visual testing: for lines from (15 to 60) lpi		Yes/No
Test with a magnifying glass (e.g. 6x):	- from 15 lpi:	to ..... lpi

Annex D
(normative)

Form D

Form D serves as the visual interpretation of the ISO-test chart 4 reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Test of the (flower) image according to picture D1
Are there clear (immediately conspicuous) differences between reproduction and test chart? Yes/No
Subjective remarks about the colour reproduction of the (flower) image, the CIE-test colours and the 16 grey steps:
.....
.....
.....

Test of the resolution in the radial gratings *W–O, W–L, W–Y, W–V* and *W–Z* according to picture D2

	W–O	***W–L***	***W–V***	***W–N***	***W–Z***
Visual testing: Is the resolution diameter < 6 mm?	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Test with magnifying glass: Resolution diameter	..... mm	.....mm	.....mm	.....mm	.....mm

Test of the 14 CIE-test colours according to picture D3
Are clear (immediately conspicuous) differences recognized between reproduction and test chart? Yes/No
If Yes: How many colours have clear differences? of the given 14 colours: .....Colours

Test of 16 visual equidistant L* -grey steps according to picture D3
Are the steps on the upper rows distinguishable? Yes/No
If No: How many steps can be distinguished of the given 16 steps: .....Steps

Test of 16 visual equidistant steps of the colour rows*W–O, W–L, W–V* and *W–N* according to picture D4
W–O White—Cyanblue: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–L White—Magentared:Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–V White—Yellow: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps
W–N White—Black: Are all steps distinguishable? Yes/No
If No: How many steps can be distinguished? of the given 16 steps: .....Steps

Test of characters and Landolt-rings in four sizes according to picture D5
Is the recognition frequency >50% for letters (17 from 32 at least) and for Landolt-rings (min. 5 of 8)?

Relative size	Letters	Rings ***N***	Rings ***O***	Rings ***L***	Rings***V***
10	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
8	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
6	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
4	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Test of the recognition frequency of the Landolt-rings *W–O, W–L, W–V* and *W–N* according to pictures D6 and D7
Is the recognition frequency of the Landolt-rings >50% (min. 5 of 8 at least)?

Colour rows***W–O***	Colour rows ***W–L***	Colour rows **W–V**	Colour rows ***W–N***
background — ring	background — ring	background — ring	background — ring
0 — 1 Yes/No	0 — 1 Yes/No	0 — 2 Yes/No	0 — 1 Yes/No
7 — 8 Yes/No	7 — 8 Yes/No	6 — 8 Yes/No	7 — 8 Yes/No
E — F Yes/No	E — F Yes/No	D — F Yes/No	E — F Yes/No
2 — 0 Yes/No	2 — 0 Yes/No	4 — 0 Yes/No	2 — 0 Yes/No
8 — 6 Yes/No	8 — 6 Yes/No	9 — 5 Yes/No	8 — 6 Yes/No
F — D Yes/No	F — D Yes/No	F — B Yes/No	F — D Yes/No

Annex E
(normative)

Form E

Form E serves as the visual interpretation of achromatic ISO-test chart (1 or 3) reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Please fill out or mark by **(x)** :
Testing "halftone (h)" test charts ( ) or "continuous tone (c)" test charts ( )
Testing achromatic test chart (1 or 3):
ISO-test chart: e. g. Test chart 3 for colour devices according to ISO 15775 (write text from bottom of ISO-test chart)
.....
ISO identification: e. g. 19980615-I0(1/3) (write code from top right side) .....
ISO-reference material: e. g. r(h/c)a4ra-I0(1/3) (write code from bottom right side) .....
File-name: e. g. E2-(1/3)CS2198 (write code from bottom left side) .....
Test of copying lines according to lines defining rectangles in the frame region:
NOTE 1 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 and 20) lines on an ISO-test chart.
How many lines are on the ISO-test chart? of max. 20 lines: .... lines are given
How many lines of ISO-test chart are copied? of given .... lines: .... lines are copied
Are the four (inner thicker) lines of the inner rectangle fully copied? Yes/No
If No: How many inner lines are fully copied? of given 4 lines: .... lines are copied
Test of agreement of the four 5-step grey scales according to the grey scales in the frame region:
NOTE 2 There are four 5-step grey scales near the four corners of the frame region. In the test chart 1and 3 they are equal to the 5-step grey scale in picture A2 and C2 respectively. The agreement can be additionally tested by measurement.
Are there clearly seen differences between the four 5-step grey scales near the four corners? Yes/No
If Yes: Indicate the one grey scale in the corners which deviates most from the average of the four grey scales.
Indicate if this grey scale is darker or lighter compared to the average.
Mark by **(x)** which grey scale (only one **(x)**) deviates most and if this grey scale is darker or lighter
top left **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
top right **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
bottom left **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
bottom right **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
Test of the scaling factors according to position marks in the frame region:
The difference of the position marks is to be measured in x- and y-direction in mm of both the reference ISO-test chart (Δx_r and Δy_r) and the copy (output Δx_o and Δy_o). The scaling factors in x- and y-direction shall be calculated by the ratios using 3 digits in mm and rounding like the example, e. g. $s_x = 1{,}01$ and $s_y = 0{,}98$:
$s_x = \Delta x_o / \Delta x_r$ $s_y = \Delta y_o / \Delta y_r$
NOTE 3 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. To get high accuracy of the two scaling factors it is recommended to measure both the original and the copy with the same ruler.
Test of the shift of the colour lines compared to black according to the lines of inner rectangle of the frame:
Are on the test chart colour lines ***(C, M, Y, O, L, V)*** belonging to the inner rectangles? Yes/No
If Yes: (answer only in that case the following questions)
NOTE 4 The lines of the inner rectangle have a linewidth of 0,3 mm. A shift of more than half of this linewidth (≥0,2 mm) can be clearly seen.
Choose one of the two horizontal lines and mark bottom or top line by x :
bottom horizontal line **( )** top horizontal line **( )**
Is there a clearly seen (≥0,2 mm) shift of a colour line ***(C, M, Y, O, L, V)*** compared to black line ***N*** ?

	C	***M***	***Y***	***O***	***L***	***V***
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
If Yes:	0,. mm	0,. mm	0,. mm	0,. mm	0,. mm	0,. mm

Choose one of the two vertical lines and mark left or right line by x:
left vertical line **( )** right vertical line **( )**
Is there a clearly seen (≥0,2 mm) shift of a colour line ***(C, M, Y, O, L, V)*** compared to the black line ***N*** ?

	C	***M***	***Y***	***O***	***L***	***V***
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
If Yes:	0,. mm	0,. Mm	0,. mm	0,. mm	0,. mm	0,. mm

Annex F
(normative)

Form F

Form F serves as the visual interpretation of chromatic ISO-test chart (2 or 4) reproduction for colour copying machines according to this document. The reproduction of this form is allowed.

Please fill out or mark by **(x)** :
Testing "halftone (h)" test charts ( ) or "continuous tone (c)" test charts ( )
Testing achromatic test chart (2 or 4):
ISO-test chart: e. g. Test chart 3 for colour devices according to ISO 15775 (write text from bottom of ISO-test chart)
.....
ISO identification: e. g. 19980615-I0(1/3) (write code from top right side) .....
ISO-reference material: e. g. r(h/c)a4ra-I0(1/3) (write code from bottom right side) .....
File-name: e. g. E2-(1/3)CS2198 (write code from bottom left side) .....
Test of copying lines according to lines defining rectangles in the frame region:
NOTE 1 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 and 20) lines on an ISO-test chart.
How many lines are on the ISO-test chart? of max. 20 lines: .... lines are given
How many lines of ISO-test chart are copied? of given .... lines: .... lines are copied
Are the four (inner thicker) lines of the inner rectangle fully copied? Yes/No
If No: How many inner lines are fully copied? of given 4 lines: .... lines are copied
Test of agreement of the four 5-step grey scales according to the grey scales in the frame region:
NOTE 2 There are four 5-step grey scales near the four corners of the frame region. In the test chart 1and 3 they are equal to the 5-step grey scale in picture A2 and C2 respectively. The agreement can be additionally tested by measurement.
Are there clearly seen differences between the four 5-step grey scales near the four corners? Yes/No
If Yes: Indicate the one grey scale in the corners which deviates most from the average of the four grey scales.
Indicate if this grey scale is darker or lighter compared to the average.
Mark by **(x)** which grey scale (only one **(x)**) deviates most and if this grey scale is darker or lighter
top left **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
top right **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
bottom left **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
bottom right **( )** if **(x)**: Is this darker **( )** or lighter **( )**?
Test of the scaling factors according to position marks in the frame region:
The difference of the position marks is to be measured in x- and y-direction in mm of both the reference ISO-test chart (Δx_r and Δy_r) and the copy (output Δx_o and Δy_o). The scaling factors in x- and y-direction shall be calculated by the ratios using 3 digits in mm and rounding like the example, e. g. $s_x = 1{,}01$ and $s_y = 0{,}98$:
$s_x = \Delta x_o / \Delta x_r$ $s_y = \Delta y_o / \Delta y_r$
NOTE 3 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. To get high accuracy of the two scaling factors it is recommended to measure both the original and the copy with the same ruler.
Test of the shift of the colour lines compared to black according to the lines of inner rectangle of the frame:
Are on the test chart colour lines ***(C, M, Y, O, L, V)*** belonging to the inner rectangles? Yes/No
If Yes: (answer only in that case the following questions)
NOTE 4 The lines of the inner rectangle have a linewidth of 0,3 mm. A shift of more than half of this linewidth (≥0,2 mm) can be clearly seen.
Choose one of the two horizontal lines and mark bottom or top line by x :
bottom horizontal line **( )** top horizontal line **( )**
Is there a clearly seen (≥0,2 mm) shift of a colour line ***(C, M, Y, O, L, V)*** compared to black line ***N*** ?

	C Yes/No	***M*** Yes/No	***Y*** Yes/No	***O*** Yes/No	***L*** Yes/No	***V*** Yes/No
If Yes:	0,. mm	0,. mm	0,. mm	0,. mm	0,. mm	0,. mm

Choose one of the two vertical lines and mark left or right line by x:
left vertical line **( )** right vertical line **( )**
Is there a clearly seen (≥0,2 mm) shift of a colour line ***(C, M, Y, O, L, V)*** compared to the black line ***N*** ?

	C Yes/No	***M*** Yes/No	***Y*** Yes/No	***O*** Yes/No	***L*** Yes/No	***V*** Yes/No
If Yes:	0,. mm	0,. Mm	0,. mm	0,. mm	0,. mm	0,. mm

Annex G
(informative)

Colourimetric specification

G.1 General

This annex provides guidance for the colourimetric specification of the ISO-test chart 1, 2, 3 and 4 reproduction for colour copying machines according to this document.

G.2 Grey scale according to picture A2 (or C2): regularity g^*

The visual lightness difference between adjacent grey steps in picture A2 (or C2) of the test charts 1 (or 3) are equal (visually "equally" spaced grey steps). This does not normally occur for the difference of the grey steps on the copies. The differences of these lightness steps are specified by the measure g^*. It describes the regularity of the lightness reproduction.

Calculation G.2: regularity g^*

For the specification of the regularity g^* the CIELAB lightness L^* of the five grey steps 1 to 5 on the copy L^*_{K1} to L^*_{K5} should be measured.

NOTE 1 The grey step 1 is the copy of the black colour (N = "Noir"), the grey step 5 is the copy of the white colour (W = White). It follows from this:

$$L^*_{K1} = L^*_{KN} \text{ and } L^*_{K5} = L^*_{KW}$$

Afterwards the lightness differences (ΔL^*_{K1} ... ΔL^*_{K4}) to the next lighter step are calculated:

$$\Delta L^*_{K1} = | L^*_{K2} - L^*_{K1} | = | L^*_{K2} - L^*_{KN} | \quad \text{(G.1)}$$

$$\Delta L^*_{K2} = | L^*_{K3} - L^*_{K2} | \quad \text{(G.2)}$$

$$\Delta L^*_{K3} = | L^*_{K4} - L^*_{K3} | \quad \text{(G.3)}$$

$$\Delta L^*_{K4} = | L^*_{K5} - L^*_{K4} | = | L^*_{KW} - L^*_{K4} | \quad \text{(G.4)}$$

The regularity g^* of the lightness scale is defined by the quotient of the smallest and greatest lightness difference (ΔL^*_{min} respectively ΔL^*_{max}) multiplied by a factor 100:

$$g^* = 100 \times \Delta L^*_{min} / \Delta L^*_{max} \quad \text{(G.5)}$$

NOTE 2 Ideally the regularity has the value $g^* = 100$. In the case where the two steps are identical the value is $g^* = 0$.

EXAMPLE Regularity g^*

$$L^*_{K1} = L^*_{KN} = 24; \quad L^*_{K2} = 40; \quad L^*_{K3} = 56; \quad L^*_{K4} = 74; \quad L^*_{K5} = L^*_{KW} = 90$$

$$\Delta L^*_{K1} = | L^*_{K2} - L^*_{K1} | = | L^*_{K2} - L^*_{KN} | = 16 = \Delta L^*_{min}$$

$\Delta L^*_{K2} = | L^*_{K3} - L^*_{K2} | = 16 = \Delta L^*_{min}$

$\Delta L^*_{K3} = | L^*_{K4} - L^*_{K3} | = 18 = \Delta L^*_{max}$

$\Delta L^*_{K4} = | L^*_{K5} - L^*_{K4}| = | L^*_{KW} - L^*_{K4} | = 16 = \Delta L^*_{min}$

$g^* = 100 \times \Delta L^*_{min} / \Delta L^*_{max} = 100 \times (16 / 18) = 89$

G.3 Grey scale according to picture A2 (or C2): lightness gamut *f**

Differences result in the lightness of black and white for the copy compared to the original. The lightness gamut *f** is specified with the lightness difference between white and black.

Calculation G.3: lightness gamut *f**

The CIELAB-lightness L^* of black *(N)* and white *(W)* in the test chart *(V)* and copy *(K)* serve for calculation of the lightness gamut *f**.

For the lightness gamut *f** the following applies:

$$f^* = 100 \, (L^*_{KW} - L^*_{KN}) / (L^*_{VW} - L^*_{VN}) \quad \text{(G.6)}$$

NOTE Ideally, when white and black are reproduced on the copy with the same lightness as in the test chart, the following values apply: $L^*_{VW} = 94$ and $L^*_{VN} = 10$.

$$f^* = 100 \, (L^*_{KW} - L^*_{KN}) / (L^*_{VW} - L^*_{VN}) = 100 \, (94 - 10) / (94 - 10) = 100$$

On devices *f** is normally smaller than 100.

EXAMPLE Lightness gamut *f**

$L^*_{K1} = L^*_{KN} = 24$; $L^*_{K5} = L^*_{KW} = 90$; $L^*_{VN} = 10$; $L^*_{VW} = 94$

$f^* = 100 \, (L^*_{KW} - L^*_{KN}) / (L^*_{VW} - L^*_{VN}) = 100 \, (90 - 24) / (94 - 10) = 79$

G.4 Grey steps according to picture A2 (or C2): mean lightness difference ΔL^*_m

The five equidistant grey steps normally show various lightness differences in the copy and the test chart. From this a mean lightness difference ΔL^*_m for the achromatic test charts 1 (or 3) can be calculated.

Calculation G.4: Mean lightness difference ΔL^*_m

The CIELAB-lightness L^* of the five grey steps of the test chart *(V)* and copy *(K)* serve for the calculation of the mean lightness difference ΔL^*_m. The lightness L^*_K of the five grey steps of the copy shall be centered on the lightness gamut of the test chart to receive the centered lightness L^*_{KZ}.

$$L^*_{KZ} = L^*_K - 0{,}5 \, [(L^*_{KN} - L^*_{VN}) - (L^*_{VW} - L^*_{KW})] \quad \text{(G.7)}$$

The mean lightness difference ΔL^*_m is calculated from the five lightness differences on the copy L^*_{KZ} and the test chart L^*_V.

$$\Delta L^*_m = 0{,}2 \, (| L^*_{KZ1} - L^*_{V1} | + | L^*_{KZ2} - L^*_{V2} | + \ldots + | L^*_{KZ5} - L^*_{V5} |) \quad \text{(G.8)}$$

NOTE 1 Ideally the mean lightness difference has the value $\Delta L^*_m = 0$.

NOTE 2 A pure regular shift of the lightness of the copy compared to the test charts (L^*_{VN} = 10 or 7, L^*_{VW} = 94 or 91) has no influence visually and will not change the calculated mean lightness difference ΔL^*_m (compare Table G.3).

EXAMPLE Mean lightness difference ΔL^*_m

$L^*_{V1} = L^*_{VN} = 10$; $L^*_{V2} = 31$; $L^*_{V3} = 52$; $L^*_{V4} = 73$; $L^*_{V5} = L^*_{VW} = 94$

$L^*_{K1} = L^*_{KN} = 24$; $L^*_{K2} = 40$; $L^*_{K3} = 56$; $L^*_{K4} = 74$; $L^*_{K5} = L^*_{KW} = 90$

$L^*_{KN} - L^*_{VN} = 24 - 10 = 14$

$L^*_{VW} - L^*_{KW} = 94 - 90 = 4$

Centralization:

$$L^*_{KZ1} = L^*_{K1} - 0{,}5\ [\ (L^*_{KN} - L^*_{VN}) - (L^*_{VW} - L^*_{KW})\ ]$$

$$L^*_{KZ1} = 24 - 0{,}5\ (14 - 4) = 19$$

$$L^*_{KZ2} = 40 - 0{,}5\ (14 - 4) = 35$$

$$L^*_{KZ3} = 56 - 0{,}5\ (14 - 4) = 51$$

$$L^*_{KZ4} = 74 - 0{,}5\ (14 - 4) = 69$$

$$L^*_{KZ5} = 90 - 0{,}5\ (14 - 4) = 85$$

Lightness difference and mean lightness difference:

$$\Delta L^*_1 = L^*_{KZ1} - L^*_{V1} = 19 - 10 = 9$$

$$\Delta L^*_2 = L^*_{KZ2} - L^*_{V2} = 35 - 31 = 4$$

$$\Delta L^*_3 = L^*_{KZ3} - L^*_{V3} = 52 - 51 = 1$$

$$\Delta L^*_4 = L^*_{KZ4} - L^*_{V4} = 69 - 73 = -4$$

$$\Delta L^*_5 = L^*_{KZ5} - L^*_{V5} = 85 - 94 = -9$$

$$\Delta L^*_m = 0{,}2\ (\ |\ L^*_{KZ1} - L^*_{V1}\ |\ +\ |\ L^*_{KZ2} - L^*_{V2}\ |\ +\ \ldots\ +\ |\ L^*_{KZ5} - L^*_{V5}\ |\ )$$

G.5 Test colours according to picture B6 (or D6): mean colour difference $\Delta E^*_{ab,m}$

The 14 test colours of a copy normally show different colour differences compared to the colours of the test chart. These differences are characterized by the mean colour difference $\Delta E^*_{ab,m}$.

Calculation G.5: mean colour difference $\Delta E^*_{ab,m}$

For the calculation of the mean colour difference $\Delta E^*_{ab,m}$ the CIELAB-lightness L^* and the red-green chromaticness a^* and yellow-blue chromaticness b^* of the 14 CIE-test colours of the test chart *(V)* and copy *(K)* in picture B6 (or D6) are measured.

From this the 14 special colour differences $\Delta E^*_{ab,i}$ (i = 1, 2, ... , 14) of copy and test chart are calculated as follows.

$$\Delta E^*_{ab,i} = [\ (L^*_{Ki} - L^*_{Vi})^2 + (a^*_{Ki} - a^*_{Vi})^2 + (b^*_{Ki} - b^*_{Vi})^2\ ]^{1/2} \quad \text{(G.9)}$$

The special colour differences $\Delta E^*_{ab,i}$ are used to define the mean colour difference $\Delta E^*_{ab,m}$:

$$\Delta E^*_{ab,m} = 0{,}0714\ (\Delta E^*_{ab,1} + \Delta E^*_{ab,2} + \Delta E^*_{ab,3} + \ldots + \Delta E^*_{ab,14}) \quad \text{(G.10)}$$

NOTE Ideally the mean colour difference has the value $\Delta E^*_{ab,m} = 0$.

EXAMPLE The mean colour difference ΔE^*ab,m is calculated from the colourimetric parameters $L^*a^*b^*$ of the test chart *(V)* and copy *(K)* with 14 special colour differences ΔE^*ab,i (i = 1, 2, ... ,14).

Table G.1 — Colourimetric parameters of CIE-test colours in ISO-test chart and the copied test chart

CIE test colour no,	Intended CIELAB data CIE 13.3 Original (V)			Produced CIELAB data of copied colours Copy (K)			CIELAB differences of test colours Difference (K-V)			CIELAB-test colour difference
	L^*_V	a^*_V	b^*_V	L^*_K	a^*_K	b^*_k	ΔL^*_{K-V}	Δa^*_{K-V}	Δb^*_{K-v}	ΔE^*_{ab}
1	61,45	17,53	11,74	60,71	18,50	9,50	-0,74	0,97	-2,24	2,55
2	60,69	0,08	28,92	58,84	3,24	23,57	-1,85	3,16	-5,35	6,48
3	62,02	-20,58	44,41	61,79	-21,49	44,33	-0,23	-0,91	-0,08	0,94
4	61,20	-33,16	17,07	62,06	-35,43	19,12	0,86	-2,27	2,05	3,18
5	62,40	-17,47	-8,55	61,70	-15,02	-10,62	-0,70	2,45	-2,07	3,28
6	61,51	-0,36	-28,39	60,17	2,47	-29,72	-1,34	2,83	-1,33	3,40
7	61,12	20,15	-24,55	63,11	17,05	-23,55	1,99	-3,10	1,00	3,82
8	62,77	27,42	-13,63	62,66	27,66	-13,57	-0,11	0,24	0,06	0,27
9	39,92	58,74	27,99	39,37	55,26	24,74	-0,55	-3,48	-3,25	4,79
10	81,26	-2,89	71,56	82,06	-2,84	81,13	0,80	0,05	9,57	9,60
11	52,23	-42,42	13,60	53,43	-44,12	16,49	1,20	-1,70	2,89	3,56
12	30,57	1,41	-46,47	29,63	4,84	-42,36	-0,94	3,43	4,11	5,44
13	80,23	11,37	21,04	78,28	12,32	20,43	-1,95	0,95	-0,61	2,25
14	40,75	-13,80	24,23	41,47	-12,47	24,78	0,72	1,33	0,55	1,61
Mean CIELAB colour difference: $\Delta E^*_{ab,m}$ = 3,7										

Table G.1 shows the $L^*a^*b^*$ data of intended and copied CIE-test colours and their CIELAB-differences.

G.6 Mean colour reproduction index $R^*_{ab,m}$

The copies of the five equidistant grey steps (pictures A2 and C2) and the 14 test colours (picture B6 and D6) indicate different colour differences compared to the corresponding steps of the test chart. These differences are characterized by the mean colour reproduction index $R^*_{ab,m.}$ It considers the mean lightness difference ΔL^*_m (for the grey steps) as well as the mean test colour difference $\Delta E^*_{ab,m}$ (for the chromatic colours).

Calculation G.6: mean colour reproduction index $R^*_{ab,m}$

The mean lightness difference ΔL^*_m according to G.4 and the mean test colour difference $\Delta E^*_{ab,m}$ according to G.5 serve for the calculation of the mean colour reproduction index.

$$R^*_{ab,m} = 100 - 4{,}6\ (\ 0{,}263\ \Delta L^*_m + 0{,}737\ \Delta E^*_{ab,m}\ ) \quad \text{(G.11)}$$

NOTE 1 Ideally the mean colour reproduction index has the value $R^*_{ab,m}$ = 100. It becomes smaller when lightness and test colour differences grow.

EXAMPLE Mean colour reproduction index $R^*_{ab,m}$

For the mean lightness difference ΔL^*_m according to the EXAMPLE in G.4 and for the mean test colour difference $\Delta E^*_{ab,m}$ according to example G.5 the following applies:

$$R^*_{ab,m} = 100 - 4{,}6\ (0{,}263\ \Delta L^*_m + 0{,}737\ \Delta E^*_{ab,m})$$

$$= 100 - 4{,}6\ (0{,}263 \times 5{,}4 + 0{,}737 \times 3{,}7) = 100 - (\ 4{,}6 \times 4{,}12\ ) = 81 \qquad \text{(G.12)}$$

NOTE 2 Results in G.2 to G.6 are rounded down to two significant digits.

G.7 Tables produced by PS-files (or equivalent)

Table G.2 — *L*a*b-Example of this annex, compare data in Table G.1 and EXAMPLE in G.3**

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to this annex
1	61,45	17,53	11,74	60,71	18,50	9,50	60,71	18,50	9,50	2,55	
2	60,69	0,08	28,92	58,84	3,24	23,57	58,84	3,24	23,57	6,48	
3	62,02	-20,58	44,41	61,79	-21,49	44,33	61,79	-21,49	44,33	0,94	
4	61,20	-33,16	17,07	62,06	-35,43	19,12	62,06	-35,43	19,12	3,18	
5	62,40	-17,47	-8,55	61,70	-15,02	-10,62	61,70	-15,02	-10,62	3,28	
6	61,51	-0,36	-28,39	60,17	2,47	-29,72	60,17	2,47	-29,72	3,41	**Regularity**
7	61,12	20,15	-24,55	63,11	17,05	-23,55	63,11	17,05	-23,55	3,82	***g**** **= 88,9**
8	62,77	27,42	-13,63	62,66	27,66	-13,57	62,66	27,66	-13,57	0,27	
9	39,92	58,74	27,99	39,37	55,26	24,74	39,37	55,26	24,74	4,79	**Lightness gamut**
10	81,26	-2,89	71,56	82,06	-2,84	81,13	82,06	-2,84	81,13	9,60	***f**** **= 78,6**
11	52,23	-42,42	13,60	53,43	-44,12	16,49	53,43	-44,12	16,49	3,56	
12	30,57	1,41	-46,47	29,63	4,84	-42,36	29,63	4,84	-42,36	5,44	
13	80,23	11,37	21,04	78,28	12,32	20,43	78,28	12,32	20,43	2,25	**Mean colour difference (14 samples)**
14	40,75	-13,8	24,23	41,47	-12,47	24,78	41,47	-12,47	24,78	1,61	ΔE^*_{CIELAB} **= 3,7**
15	10,00	0,01	0,01	24,00	0,00	0,00	24,00	0,00	0,00	14,00	
16	94,00	0,01	0,01	90,00	0,00	0,00	90,00	0,00	0,00	4,00	
17	10,00	0,01	0,01	24,00	0,00	0,00	19,00	0,00	0,00	9,00	
18	31,00	0,01	0,01	40,00	0,00	0,00	35,00	0,00	0,00	4,00	
19	52,00	0,01	0,01	56,00	0,00	0,00	51,00	0,00	0,00	1,00	
20	73,00	0,01	0,01	74,00	0,00	0,00	69,00	0,00	0,00	4,00	**Mean lightness difference (5 steps)**
21	94,00	0,01	0,01	90,00	0,00	0,00	85,00	0,00	0,00	9,00	ΔL^*_{CIELAB} **= 5,4**

Table G.3 — *L*a*b-Example with reference data in halftone and output data in continuous tone technique**

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to this annex
1	10,00	0,00	0,00	7,00	0,00	0,00	7,00	0,00	0,00	3,00	
2	15,60	0,00	0,00	12,60	0,00	0,00	12,60	0,00	0,00	3,00	
3	21,20	0,00	0,00	18,20	0,00	0,00	18,20	0,00	0,00	3,00	

Table G.3 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	**Specification according to this annex**
4	26,80	0,00	0,00	23,80	0,00	0,00	23,80	0,00	0,00	3,00	
5	32,40	0,00	0,00	29,40	0,00	0,00	29,40	0,00	0,00	3,00	
6	38,00	0,00	0,00	35,00	0,00	0,00	35,00	0,00	0,00	3,00	**Regularity**
7	43,60	0,00	0,00	40,60	0,00	0,00	40,60	0,00	0,00	3,00	***g*** = 100,0*
8	49,20	0,00	0,00	46,20	0,00	0,00	46,20	0,00	0,00	3,00	
9	54,80	0,00	0,00	51,80	0,00	0,00	51,80	0,00	0,00	3,00	**Lightness gamut**
10	60,40	0,00	0,00	57,40	0,00	0,00	57,40	0,00	0,00	3,00	***f*** = 100,0*
11	66,00	0,00	0,00	63,00	0,00	0,00	63,00	0,00	0,00	3,00	
12	71,60	0,00	0,00	68,60	0,00	0,00	68,60	0,00	0,00	3,00	
13	77,20	0,00	0,00	74,20	0,00	0,00	74,20	0,00	0,00	3,00	
14	82,80	0,00	0,00	79,80	0,00	0,00	79,80	0,00	0,00	3,00	
15	88,40	0,00	0,00	85,40	0,00	0,00	85,40	0,00	0,00	3,00	**Mean colour difference (16 samples)**
16	94,00	0,00	0,00	91,00	0,00	0,00	91,00	0,00	0,00	3,00	ΔE^*_{CIELAB} **= 3,0**
17	10,00	0,00	0,00	7,00	0,00	0,00	10,00	0,00	0,00	0,01	
18	31,00	0,00	0,00	28,00	0,00	0,00	31,00	0,00	0,00	0,01	
19	52,00	0,00	0,00	49,00	0,00	0,00	52,00	0,00	0,00	0,01	
20	73,00	0,00	0,00	70,00	0,00	0,00	73,00	0,00	0,00	0,01	**Mean lightness difference (5 steps)**
21	94,00	0,00	0,00	91,00	0,00	0,00	94,00	0,00	0,00	0,01	ΔL^*_{CIELAB} **= 0,0**
Mean colour reproduction index: $R^*_{ab,m}$ **= 89**											

Table G.4 — *L*a*b-Example with reference data in continuous and output data in continuous tone technique**

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	**Specification according to this annex**
1	7,00	0,00	0,00	7,00	0,00	0,00	7,00	0,00	0,00	0,01	
2	12,60	0,00	0,00	12,60	0,00	0,00	12,60	0,00	0,00	0,01	
3	18,20	0,00	0,00	18,20	0,00	0,00	18,20	0,00	0,00	0,01	
4	23,80	0,00	0,00	23,80	0,00	0,00	23,80	0,00	0,00	0,01	
5	29,40	0,00	0,00	29,40	0,00	0,00	29,40	0,00	0,00	0,01	
6	35,00	0,00	0,00	35,00	0,00	0,00	35,00	0,00	0,00	0,01	**Regularity**
7	40,60	0,00	0,00	40,60	0,00	0,00	40,60	0,00	0,00	0,01	***g*** = 100,0*
8	46,20	0,00	0,00	46,20	0,00	0,00	46,20	0,00	0,00	0,01	
9	51,80	0,00	0,00	51,80	0,00	0,00	51,80	0,00	0,00	0,01	**Lightness gamut**
10	57,40	0,00	0,00	57,40	0,00	0,00	57,40	0,00	0,00	0,01	***f*** = 100,0*
11	63,00	0,00	0,00	63,00	0,00	0,00	63,00	0,00	0,00	0,01	
12	68,60	0,00	0,00	68,60	0,00	0,00	68,60	0,00	0,00	0,01	
13	74,20	0,00	0,00	74,20	0,00	0,00	74,20	0,00	0,00	0,01	
14	79,80	0,00	0,00	79,80	0,00	0,00	79,80	0,00	0,00	0,01	
15	85,40	0,00	0,00	85,40	0,00	0,00	85,40	0,00	0,00	0,01	**Mean colour difference (16 samples)**
16	91,00	0,00	0,00	91,00	0,00	0,00	91,00	0,00	0,00	0,01	ΔE^*_{CIELAB} **= 0,0**

Table G.4 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	**Specification according to this annex**
17	7,00	0,00	0,00	7,00	0,00	0,00	7,00	0,00	0,00	0,01	
18	28,00	0,00	0,00	28,00	0,00	0,00	28,00	0,00	0,00	0,01	
19	49,00	0,00	0,00	49,00	0,00	0,00	49,00	0,00	0,00	0,01	
20	70,00	0,00	0,00	70,00	0,00	0,00	70,00	0,00	0,00	0,01	**Mean lightness difference (5 steps)**
21	91,00	0,00	0,00	91,00	0,00	0,00	91,00	0,00	0,00	0,01	ΔL^*_{CIELAB} **= 0,0**
Mean colour reproduction index: $R^*_{ab,m}$ = 100											

Table G.2 shows *L*a*b**-Example of this annex, compare data in Table G.1 and the EXAMPLE in G.4.

Table G.3 shows *L*a*b**-Example with reference data in halftone reproduction and (ideal) output data in continuous tone reproduction. There is a shift in lightness data to centred lightness data for colours 17 to 21 (see calculation G.4). This leads to a mean lightness difference of $\Delta L^*_m = 0$.

Table G.4 shows *L*a*b**-Example with reference data in continuous tone reproduction and output data for continuous tone reproduction. There is no shift in lightness data to centred lightness data for colours 17 to 21. This leads to a mean lightness difference of $\Delta L^*_m = 0$.

Tables G.1 to G.4 are designed by PS-files (or equivalent). The terms regularity g^*, lightness gamut f^*, mean colour difference $\Delta E^*_{ab,m}$ and mean lightness difference ΔL^*_m, and mean colour reproduction index $R^*_{ab,m}$ are computed by the PS-file (or equivalent) code.

NOTE 1 The *L*a*b** colourimetric data can be included with a text editor normally at the beginning in the EPS-program files (or equivalent). The PS-file (or equivalent) can be sent to a PS-printer (or equivalent) which formats the tables and calculate the results (regularity, mean lightness difference, mean colour difference, mean colour reproduction index).

NOTE 2 This PS-formatting and the PS-calculations (or equivalent) are done also by free PS-Viewers on monitors and by Display-PostScript systems (or equivalent). The results seen on monitors or as output on printers are similar to Tables G.2 to G.4, and H.1 to H.11. Under each table there is a filename which helps to find the corresponding file for a user application.

NOTE 3 The PS-files (or equivalent) producing useful formatted tables are given as "Technical information" on the ISO maintenance portal (see Annex M).

NOTE 4 The software Adobe Acrobat Distiller can transform the format PS or EPS (or equivalent) into the format PDF (or equivalent). PDF-files can be displayed and printed by the software Adobe Acrobat Reader which is license free available for nearly any operating system (Mac, Unix, Windows).

Annex H
(informative)

Intended and produced colours

This annex gives information about intended colours and the average CIELAB colourimetric data for the actual DIN-test charts no. 1, 2, 3 and 4 produced. In the pictures there are 14 CIE-test colours and different 16-step colour series *W–N*, *W–C*, *W–M*, *W–Y*, *W–O*, W–*L*, and *W–V*. There is only one 5-step grey series in test chart 1 (or 3).

NOTE 1 The colourimetric *L*a*b**-data of the 5-step series are linearly interpolated from the 16-step data within the PS-file (or equivalent) which produces the following Tables H.1 to H.11. There is no significant difference for the calculation of the mean colour difference (5 samples) using the interpolated data of the 16-step and the 5-step data measured in picture A2 (maximum variation about 2 CIELAB-units). Therefore, interpolated data can be used.

In actual printing the 5-step colour series were additionally printed outside the test DIN-test chart 2 area. For the 5-step series a comparison of these measured data with the interpolated data show no significant differences (maximum variation about 2 CIELAB-units). Therefore, interpolated data can be used.

Table H.1 shows data for the 16-step and 5-step series white–black *W–N* of achromatic DIN-test chart 1, picture A3. The mean (average) colour and lightness differences (see Annex G) are given on the right side. These numbers are computed using the method given in Annex G.

Tables H.2 to H.4 show data for the 16-step and 5-step series white–cyan *W–C*, white–magenta *W–M*, and white– yellow *W–Y* of chromatic DIN-test chart 2, picture B2. The mean (average) colour differences for 16 and 5 samples (see Annex G) are given on the right side. These numbers are computed using the method given in Annex G.

NOTE 2 Picture B2 of DIN-test chart 2 includes only the 16-steps series and no 5 step series.

Table H.5 shows data for the 14 CIE-test colours of DIN-test chart 2, picture B6 and the 5-step series white–black *W–N* of DIN-test chart 1, picture A2. In Table H.5 for the colours *i* = 15 and 16 black and white (no. 17 and 21) are used again. The mean (average) colour and lightness differences (see Annex G) of 14 CIE-test colours and 5 achromatic colours are given on the right side. These numbers are computed using the method given in Annex G.

Table H.6 shows data for the 16-step and 5-step series white–black *W–N* of achromatic DIN-test chart 3, picture A3 (offset). The mean (average) colour and lightness differences (see Annex G) are given on the right side. These numbers are computed using the method given in Annex G.

Tables H.7 to H.9 show data for the 16-step and 5-step series white–orange-red *W–O*, white–leafgreen W–*L*, and white–violetblue *W–V* of chromatic DIN-test chart 4, picture C2. The mean (average) colour differences for 16 and 5 samples (see Annex G) are given on the right side. These numbers are computed using the method given in Annex G.

NOTE 3 Picture C2 of DIN-test chart 4 includes only the 16-steps series and no 5 step series.

Table H.10 shows data for the 14 CIE-test colours of DIN-test chart 4, picture C6 and the 5-step series White–Black *W–N* of DIN-test chart 3, picture A2 (offset). In Table H.10 for the colours *i* = 15 and 16 black and white (no. 17 and 21) are used again. The mean (average) colour and lightness differences (see Annex G) of 14 CIE-test colours and 5 achromatic colours are given on the right side. These numbers are computed using the method given in Annex G.

Table H.11 shows data for the 14 CIE-test colours of DIN-test chart 4, picture C1 (pixel image) and the 5-step series White–Black *W–N* of DIN-test chart 1, picture A2. In Table H.11 for the colours *i* = 15 and

16 black and white (no. 17 and 21) are used again. The mean (average) colour and lightness differences (see Annex G) of 14 CIE-test colours and 5 achromatic colours are given on the right side. These numbers are computed using the method given in Annex G.

NOTE 4 Users can find on the websites (see Annex M) PS-files (or equivalent) which uses the data of Annexes G and H and calculates the results of Annexes G and H within a PS-Printer (or equivalent) or by a PS- interpreter (or equivalent) or by the Adobe Acrobat[2)] software (or equivalent). User may calculate colour differences for different applications with these PS-files (or equivalent).

NOTE 5 The software Adobe Acrobat Distiller can transform the format PS or EPS (or equivalent) into the format PDF (or equivalent). PDF-files (or equivalent) can be displayed and printed by the software Adobe Acrobat Reader (or equivalent) which is license free available for nearly any operating system (Mac, Unix, Windows).

Table H.1 — Colourimetric data of series W–N, DIN 33866 test chart no. 1, picture A3

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	10,00	0,00	0,00	10,12	1,80	4,51	10,12	1,80	4,51	4,86	
2	15,60	0,00	0,00	14,89	1,26	3,34	14,89	1,26	3,34	3,64	
3	21,20	0,00	0,00	20,63	0,73	2,20	20,63	0,73	2,20	2,39	
4	26,80	0,00	0,00	26,45	0,47	1,18	26,45	0,47	1,18	1,32	
5	32,40	0,00	0,00	32,27	0,30	0,48	32,27	0,30	0,48	0,58	
6	38,00	0,00	0,00	36,67	0,22	0,09	36,67	0,22	0,09	1,35	**Regularity**
7	43,60	0,00	0,00	41,10	0,18	-0,33	41,10	0,18	-0,33	2,53	$g^* = 82,2$
8	49,20	0,00	0,00	46,45	0,15	-0,75	46,45	0,15	-0,75	2,86	
9	54,80	0,00	0,00	52,06	0,12	-1,14	52,06	0,12	-1,14	2,97	**Lightness gamut**
10	60,40	0,00	0,00	57,79	0,13	-1,49	57,79	0,13	-1,49	3,01	$f^* = 99,3$
11	66,00	0,00	0,00	63,85	0,14	-1,71	63,85	0,14	-1,71	2,76	
12	71,60	0,00	0,00	69,73	0,21	-1,77	69,73	0,21	-1,77	2,59	
13	77,20	0,00	0,00	75,19	0,27	-1,74	75,19	0,27	-1,74	2,68	
14	82,80	0,00	0,00	80,74	0,37	-1,57	80,74	0,37	-1,57	2,62	
15	88,40	0,00	0,00	88,06	0,54	-1,45	88,06	0,54	-1,45	1,59	**Mean colour difference (16 samples)**
16	94,00	0,00	0,00	93,54	0,66	-1,45	93,54	0,66	-1,45	1,67	$\Delta E^*_{CIELAB} = 2,5$
17	10,00	0,00	0,00	10,12	1,80	4,51	10,29	1,80	4,51	4,86	
18	31,00	0,00	0,00	30,82	0,34	0,66	30,99	0,34	0,66	0,74	
19	52,00	0,00	0,00	49,26	0,14	-0,95	49,43	0,14	-0,95	2,75	
20	73,00	0,00	0,00	71,10	0,23	-1,76	71,27	0,23	-1,76	2,49	**Mean colour difference (5 samples)**
21	94,00	0,00	0,00	93,54	0,66	-1,45	93,71	0,66	-1,45	1,63	$\Delta L^*_{CIELAB} = 2,5$
Mean colour reproduction index: $R^*_{ab,m} = 89$											

Table H.2 — Colourimetric data of series W–C, DIN 33866 test chart no. 2, picture B2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	58,62	-30,62	-42,74	59,96	-27,81	-43,16	59,96	-27,81	-43,16	3,14	
2	61,07	-28,64	-39,57	63,24	-27,48	-39,6	63,24	-27,48	-39,6	2,46	
3	63,53	-26,67	-36,41	67,36	-25,20	-34,41	67,36	-25,20	-34,41	4,57	

2) Adobe Acrobat, Adobe Acrobat Distiller and Adobe Acrobat Reader are examples of suitable products 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 these products.

Table H.2 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
4	65,98	-24,69	-33,24	70,03	-23,12	-30,98	70,03	-23,12	-30,98	4,90	
5	68,43	-22,72	-30,07	71,43	-21,85	-29,08	71,43	-21,85	-29,08	3,28	
6	70,88	-20,74	-26,9	73,73	-20,17	-25,99	73,73	-20,17	-25,99	3,04	**Regularity**
7	73,34	-18,76	-23,74	75,98	-18,49	-22,98	75,98	-18,49	-22,98	2,76	***g** = 63,5**
8	75,79	-16,79	-20,57	78,81	-15,97	-19,01	78,81	-15,97	-19,01	3,50	
9	78,24	-14,81	-17,4	81,34	-13,97	-15,66	81,34	-13,97	-15,66	3,65	**Lightness gamut**
10	80,69	-12,84	-14,23	83,36	-12,12	-12,58	83,36	-12,12	-12,58	3,22	***f** = 41,9**
11	83,15	-10,86	-11,07	85,70	-10,37	-9,91	85,70	-10,37	-9,91	2,85	
12	85,60	-8,88	-7,90	87,13	-9,15	-8,02	87,13	-9,15	-8,02	1,56	
13	88,05	-6,91	-4,73	90,94	-5,11	-2,55	90,94	-5,11	-2,55	4,04	
14	90,50	-4,93	-1,56	92,49	-3,34	-0,39	92,49	-3,34	-0,39	2,80	
15	92,96	-2,96	1,59	93,79	-1,93	1,59	93,79	-1,93	1,59	1,32	**Mean colour difference (16 samples)**
16	95,41	-0,98	4,76	95,14	-0,60	3,26	95,14	-0,6	3,26	1,57	ΔE^*_{CIELAB} **= 3,0**
17	58,62	-30,62	-42,74	59,96	-27,81	-43,16	59,43	-27,81	-43,16	2,95	
18	67,82	-23,21	-30,86	71,08	-22,17	-29,56	70,55	-22,17	-29,56	3,20	
19	77,02	-15,8	-18,98	80,07	-14,97	-17,34	79,54	-14,97	-17,34	3,13	
20	86,21	-8,39	-7,11	88,08	-8,14	-6,65	87,55	-8,14	-6,65	1,43	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	95,14	-0,60	3,26	94,61	-0,60	3,26	1,74	ΔL^*_{CIELAB} **= 2,5**
Mean colour reproduction index: $R^*_{ab,m}$ **= 87**											

Table H.3 — Colourimetric data of series W–M, DIN 33866 test chart no. 2, picture B2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	48,13	75,20	-6,79	49,19	74,03	-7,41	49,19	74,03	-7,41	1,70	
2	51,28	70,12	-6,02	53,16	66,88	-9,5	53,16	66,88	-9,50	5,11	
3	54,43	65,04	-5,25	57,04	59,38	-9,11	57,04	59,38	-9,11	7,33	
4	57,59	59,96	-4,48	61,14	51,84	-8,47	61,14	51,84	-8,47	9,72	
5	60,74	54,88	-3,71	63,23	47,81	-7,82	63,23	47,81	-7,82	8,55	
6	63,89	49,80	-2,94	65,47	44,40	-7,62	65,47	44,40	-7,62	7,32	**Regularity**
7	67,04	44,72	-2,17	68,64	38,96	-6,82	68,64	38,96	-6,82	7,58	***g** = 71,6**
8	70,19	39,64	-1,40	71,98	33,83	-5,92	71,98	33,83	-5,92	7,58	
9	73,35	34,57	-0,62	75,23	28,99	-4,99	75,23	28,99	-4,99	7,33	**Lightness gamut**
10	76,50	29,49	0,14	78,16	24,54	-3,99	78,16	24,54	-3,99	6,66	***f** = 54,3**
11	79,65	24,41	0,91	81,06	20,35	-3,26	81,06	20,35	-3,26	5,99	
12	82,80	19,33	1,68	83,97	15,51	-2,19	83,97	15,51	-2,19	5,57	
13	85,95	14,25	2,45	88,52	9,34	-0,22	88,52	9,34	-0,22	6,15	
14	89,11	9,17	3,22	91,58	4,61	1,42	91,58	4,61	1,42	5,49	
15	92,26	4,09	3,99	93,12	2,03	2,31	93,12	2,03	2,31	2,79	**Mean colour difference (16 samples)**
16	95,41	-0,98	4,76	94,78	-0,60	3,36	94,78	-0,60	3,36	1,58	ΔE^*_{CIELAB} **= 6,0**
17	48,13	75,20	-6,79	49,19	74,03	-7,41	48,98	74,03	-7,41	1,57	
18	59,95	56,15	-3,90	62,71	48,82	-7,98	62,49	48,82	-7,98	8,77	

Table H.3 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
19	71,77	37,11	-1,01	73,61	31,41	-5,46	73,39	31,41	-5,46	7,40	
20	83,59	18,06	1,87	85,11	13,97	-1,70	84,89	13,97	-1,70	5,59	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	94,78	-0,60	3,36	94,57	-0,60	3,36	1,68	**ΔL^*_{CIELAB} = 5,0**
Mean colour reproduction index: $R^*_{ab,m}$ = 73											

Table H.4 — Colourimetric data of series W–Y, DIN 33866 test chart no. 2, picture B2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	90,37	-11,15	96,17	87,12	-5,59	105,61	87,12	-5,59	105,61	11,43	
2	90,71	-10,47	90,08	87,68	-6,88	101,04	87,68	-6,88	101,04	11,93	
3	91,04	-9,79	83,98	88,13	-7,59	94,37	88,13	-7,59	94,37	11,01	
4	91,38	-9,12	77,89	88,60	-7,93	86,35	88,60	-7,93	86,35	8,98	
5	91,71	-8,44	71,79	89,06	-7,88	76,07	89,06	-7,88	76,07	5,06	
6	92,05	-7,76	65,70	89,78	-7,70	68,80	89,78	-7,70	68,80	3,84	**Regularity**
7	92,39	-7,08	59,61	90,06	-7,22	59,16	90,06	-7,22	59,16	2,37	**g^* = 70,6**
8	92,72	-6,40	53,51	90,32	-7,30	55,33	90,32	-7,30	55,33	3,14	
9	93,06	-5,73	47,42	90,95	-7,04	49,91	90,95	-7,04	49,91	3,52	**Lightness gamut**
10	93,39	-5,05	41,32	91,52	-6,57	43,07	91,52	-6,57	43,07	2,98	**f^* = 9,8**
11	93,73	-4,37	35,23	92,41	-6,00	35,41	92,41	-6,00	35,41	2,11	
12	94,07	-3,69	29,14	92,75	-5,30	28,29	92,75	-5,30	28,29	2,24	
13	94,40	-3,01	23,04	93,46	-4,32	21,25	93,46	-4,32	21,25	2,41	
14	94,74	-2,34	16,95	94,40	-2,86	13,19	94,40	-2,86	13,19	3,81	
15	95,07	-1,66	10,85	94,65	-2,02	9,31	94,65	-2,02	9,31	1,64	**Mean colour difference (16 samples)**
16	95,41	-0,98	4,76	95,32	-0,58	3,35	95,32	-0,58	3,35	1,47	**ΔE^*_{CIELAB} = 4,9**
17	90,37	-11,15	96,17	87,12	-5,59	105,61	88,79	-5,59	105,61	11,07	
18	91,63	-8,61	73,32	88,95	-7,89	78,64	90,62	-7,89	78,64	5,47	
19	92,89	-6,07	50,47	90,63	-7,17	52,62	92,30	-7,17	52,62	2,49	
20	94,15	-3,52	27,61	92,93	-5,06	26,53	94,60	-5,06	26,53	1,93	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	95,32	-0,58	3,35	96,99	-0,58	3,35	2,16	**ΔL^*_{CIELAB} = 4,6**
Mean colour reproduction index: $R^*_{ab,m}$ = 78											

Table H.5 — Colourimetric data of CIE-colours (DIN 33866 no. 2, B6) and series *W–N* (DIN 33866 no. 1, A2)

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	61,45	17,53	11,74	56,80	12,93	19,60	56,80	12,93	19,60	10,23	
2	60,69	0,08	28,92	55,00	-2,42	35,85	55,00	-2,42	35,85	9,31	
3	62,02	-20,58	44,41	56,74	-24,61	42,51	56,74	-24,61	42,51	6,91	
4	61,20	-33,16	17,07	60,90	-48,14	23,62	60,90	-48,14	23,62	16,35	

Table H.5 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
5	62,40	-17,47	-8,55	58,17	-19,98	-13,31	58,17	-19,98	-13,31	6,84	
6	61,51	-0,36	-28,39	57,44	0,10	-31,83	57,44	0,10	-31,83	5,35	**Regularity**
7	61,12	20,15	-24,55	56,85	18,29	-25,86	56,85	18,29	-25,86	4,84	***g*** = 90,5*
8	62,77	27,42	-13,63	57,87	27,63	-21,75	57,87	27,63	-21,75	9,49	
9	39,92	58,74	27,99	41,87	38,70	33,27	41,87	38,70	33,27	20,82	**Lightness gamut**
10	81,26	-2,89	71,56	75,56	4,20	74,01	75,56	4,20	74,01	9,43	***f*** = 99,2*
11	52,23	-42,42	13,60	47,15	-47,28	18,53	47,15	-47,28	18,53	8,59	
12	30,57	1,41	-46,47	34,80	1,37	-28,6	34,80	1,37	-28,6	18,36	
13	80,23	11,37	21,04	77,59	15,62	29,57	77,59	15,62	29,57	9,89	**Mean colour difference (14 samples)**
14	40,75	-13,8	24,23	36,07	-18,23	23,81	36,07	-18,23	23,81	6,46	ΔE^*_{CIELAB} **= 10,2**
15	10,00	0,00	0,00	10,07	1,83	4,48	10,07	1,83	4,48	4,84	
16	94,00	0,00	0,00	93,39	0,76	-1,63	93,39	0,76	-1,63	1,91	
17	10,00	0,00	0,00	10,07	1,83	4,48	10,34	1,83	4,48	4,85	
18	31,00	0,00	0,00	29,99	0,35	0,80	30,26	0,35	0,80	1,14	
19	52,00	0,00	0,00	50,74	0,15	-1,23	51,01	0,15	-1,23	1,59	
20	73,00	0,00	0,00	71,39	0,27	-1,88	71,66	0,27	-1,88	2,33	**Mean colour difference (5 samples)**
21	94,00	0,00	0,00	93,39	0,76	-1,63	93,66	0,76	-1,63	1,84	ΔL^*_{CIELAB} **= 2,4**
Mean colour reproduction index: $R^*_{ab,m}$ **= 63**											

Table H.6 — Colourimetric data of series W-N, DIN 33866 test chart no. 3, picture A3 (offset)

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	18,01	0,5	-0,46	17,16	-0,07	-2,72	17,16	-0,07	-2,72	2,48	
2	23,17	0,4	-0,11	24,07	-0,15	-2,75	24,07	-0,15	-2,75	2,84	
3	28,33	0,3	0,23	30,85	-0,23	-2,54	30,85	-0,23	-2,54	3,79	
4	33,49	0,2	0,58	38,41	-0,43	-2,3	38,41	-0,43	-2,3	5,74	
5	38,65	0,1	0,92	42,77	-0,48	-2,13	42,77	-0,48	-2,13	5,17	
6	43,81	0	1,27	47,15	-0,74	-1,64	47,15	-0,74	-1,64	4,5	**Regularity**
7	48,97	-0,09	1,62	52,89	-0,79	-1,44	52,89	-0,79	-1,44	5,03	**g* = 69,2**
8	54,13	-0,19	1,97	56,25	-0,79	-1,25	56,25	-0,79	-1,25	3,91	
9	59,29	-0,28	2,32	61,07	-0,8	-1,07	61,07	-0,8	-1,07	3,87	**Lightness gamut**
10	64,45	-0,38	2,67	66,47	-0,74	-0,63	66,47	-0,74	-0,63	3,89	***f*** = 92,6*
11	69,61	-0,48	3,02	70,36	-0,79	-0,12	70,36	-0,79	-0,12	3,25	
12	74,77	-0,58	3,37	75,35	-0,7	0,4	75,35	-0,7	0,4	3,02	
13	79,93	-0,68	3,71	79,87	-0,71	0,98	79,87	-0,71	0,98	2,73	
14	85,09	-0,78	4,06	87,58	-0,66	2,11	87,58	-0,66	2,11	3,17	
15	90,25	-0,88	4,41	91,78	-0,6	2,74	91,78	-0,6	2,74	2,28	**Mean colour difference (5 samples)**
16	95,41	-0,98	4,76	94,98	-0,59	3,28	94,98	-0,59	3,28	1,59	ΔE^*_{CIELAB} **= 3,6**
17	18,01	0,5	-0,46	17,16	-0,07	-2,72	17,8	-0,07	-2,72	2,34	
18	37,36	0,13	0,84	41,68	-0,47	-2,17	42,32	-0,47	-2,17	5,84	

Table H.6 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
19	56,71	-0,24	2,15	58,66	-0,8	-1,16	59,3	-0,8	-1,16	4,24	
20	76,06	-0,61	3,45	76,48	-0,7	0,55	77,12	-0,7	0,55	3,1	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	94,98	-0,59	3,28	95,62	-0,59	3,28	1,54	ΔL^*_{CIELAB} **= 3,4**
Mean colour reproduction index: $R^*_{ab,m}$ = 84											

Table H.7 — Colourimetric data of series W–O, DIN 33866 test chart no. 4, picture C2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	47,94	65,31	52,07	47,94	65,31	52,07	47,94	65,31	52,07	0,01	
2	51,10	60,89	48,92	50,89	59,79	54,27	50,89	59,79	54,27	5,47	
3	54,27	56,47	45,76	54,06	53,38	54,48	54,06	53,38	54,48	9,25	
4	57,43	52,05	42,61	58,01	45,94	51,53	58,01	45,94	51,53	10,83	
5	60,60	47,63	39,45	60,40	41,71	46,80	60,40	41,71	46,80	9,44	
6	63,76	43,21	36,30	62,24	38,64	42,92	62,24	38,64	42,92	8,19	**Regularity**
7	66,93	38,79	33,15	65,28	33,73	39,02	65,28	33,73	39,02	7,93	g^* **= 82,9**
8	70,09	34,37	29,99	68,69	28,62	35,04	68,69	28,62	35,04	7,78	
9	73,26	29,95	26,84	71,86	23,14	32,75	71,86	23,14	32,75	9,13	**Lightness gamut**
10	76,42	25,53	23,68	74,86	19,22	29,35	74,86	19,22	29,35	8,62	f^* **= 56,6**
11	79,59	21,11	20,53	78,27	15,77	24,44	78,27	15,77	24,44	6,75	
12	82,75	16,69	17,38	81,66	11,94	20,14	81,66	11,94	20,14	5,60	
13	85,92	12,27	14,22	86,43	6,51	16,02	86,43	6,51	16,02	6,06	
14	89,08	7,85	11,07	90,57	2,64	11,30	90,57	2,64	11,30	5,42	
15	92,25	3,43	7,91	93,09	0,60	8,22	93,09	0,60	8,22	2,97	**Mean colour difference (16 samples)**
16	95,41	-0,98	4,76	95,49	-0,59	3,20	95,49	-0,59	3,20	1,61	ΔE^*_{CIELAB} **= 6,6**
17	47,94	65,31	52,07	47,94	65,31	52,07	47,90	65,31	52,07	0,04	
18	59,81	48,74	40,24	59,80	42,77	47,98	59,76	42,77	47,98	9,77	
19	71,68	32,16	28,42	70,28	25,88	33,90	70,24	25,88	33,90	8,46	
20	83,54	15,58	16,59	82,85	10,58	19,11	82,81	10,58	19,11	5,65	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	95,49	-0,59	3,20	95,45	-0,59	3,20	1,61	ΔL^*_{CIELAB} **= 5,1**
Mean colour reproduction index: $R^*_{ab,m}$ = 71											

Table H.8 — Colourimetric data of series W–O, DIN 33866 test chart no. 4, picture C2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	50,9	-62,96	36,7	50,9	-62,96	36,7	50,9	-62,96	36,7	0.0	
2	53,9	-58,83	34,6	54,7	-59,34	42,4	54,7	-59,34	42,4	7,9	
3	56,8	-54,7	32,5	59,2	-51,75	45,7	59,2	-51,75	45,7	13,8	
4	59,8	-50,56	30,3	62,8	-45,88	44,9	62,8	-45,88	44,9	15,6	
5	62,8	-46,43	28,2	64,7	-42,59	39,4	64,7	-42,59	39,4	12,0	
6	65,7	-42,3	26,1	66,9	-39,23	36,5	66,9	-39,23	36,5	10,9	**Regularity**

Table H.8 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
7	68,7	-38,17	23,9	70,0	-34,38	30,5	70,0	-34,38	30,5	7,7	***g*** = 70,8*
8	71,7	-34,04	21,8	73,5	-29,69	29,1	73,5	-29,69	29,1	8,7	
9	74,6	-29,9	19,7	76,8	-25,35	26,2	76,8	-25,35	26,2	8,2	**Lightness gamut**
10	77,6	-25,77	17,5	79,8	-21,49	23,5	79,8	-21,49	23,5	7,7	***f*** = 53,0*
11	80,6	-21,64	15,4	82,5	-18,23	19,6	82,5	-18,23	19,6	5,7	
12	83,5	-17,51	13,3	84,9	-15,16	15,1	84,9	-15,16	15,1	3,2	
13	86,5	-13,38	11,2	89,3	-9,27	14,7	89,3	-9,27	14,7	6,1	
14	89,5	-9,24	9,0	91,6	-5,89	9,6	91,6	-5,89	9,6	4,0	
15	92,4	-5,11	6,9	93,7	-3,38	7,8	93,7	-3,38	7,8	2,3	**Mean colour difference (16 samples)**
16	95,4	-0,98	4,8	95,4	-0,63	3,3	95,4	-0,63	3,3	1,5	ΔE^*_{CIELAB} = 7,2
17	50,9	-62,96	36,7	50,9	-62,96	36,7	50,9	-62,96	36,7	0,0	
18	62,0	-47,47	28,7	64,2	-43,41	40,7	64,2	-43,41	40,7	12,9	
19	73,2	-31,97	20,7	75,1	-27,52	27,7	75,1	-27,52	27,7	8,5	
20	84,3	-16,48	12,8	86,0	-13,69	15,0	86,0	-13,69	15,0	4,0	**Mean colour difference (5 samples)**
21	95,4	-0,98	4,8	95,4	-0,63	3,3	95,4	-0,63	3,3	1,5	ΔL^*_{CIELAB} = 5,4
Mean colour reproduction index: $R^*_{ab,m}$ = 69											

Table H.9 — Colourimetric data of series W–V, DIN 33866 test chart no. 4, picture C2

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	25,72	31,45	-44,35	25,72	31,45	-44,35	25,72	31,45	-44,35	0,01	
2	30,37	29,29	-41,08	31,69	26,38	-42,58	31,69	26,38	-42,58	3,53	
3	35,01	27,12	-37,8	37,74	24,19	-38,7	37,74	24,19	-38,7	4,11	
4	39,66	24,96	-34,53	42,72	21,13	-35,99	42,72	21,13	-35,99	5,12	
5	44,30	22,80	-31,25	45,93	19,37	-33,83	45,93	19,37	-33,83	4,59	
6	48,95	20,64	-27,98	49,58	18,09	-31,26	49,58	18,09	-31,26	4,20	**Regularity**
7	53,60	18,47	-24,7	53,47	16,15	-28,52	53,47	16,15	-28,52	4,47	***g*** = 81,8*
8	58,24	16,31	-21,43	58,97	14,32	-24,7	58,97	14,32	-24,7	3,90	
9	62,89	14,15	-18,15	63,03	12,58	-22,12	63,03	12,58	-22,12	4,27	**Lightness gamut**
10	67,53	11,99	-14,88	67,84	10,83	-18,83	67,84	10,83	-18,83	4,13	***f*** = 82,8*
11	72,18	9,82	-11,6	71,85	9,27	-15,8	71,85	9,27	-15,8	4,25	
12	76,83	7,66	-8,33	75,70	6,71	-13,31	75,70	6,71	-13,31	5,19	
13	81,47	5,50	-5,05	83,00	5,10	-7,0	83,00	5,10	-7,0	2,51	
14	86,12	3,34	-1,78	88,02	1,70	-3,1	88,02	1,70	-3,1	2,83	
15	90,76	1,17	1,49	91,95	0,59	0,34	91,95	0,59	0,34	1,75	**Mean colour difference (16 samples)**
16	95,41	-0,98	4,76	95,31	-0,59	3,30	95,31	-0,59	3,30	1,51	ΔE^*_{CIELAB} = 3,5
17	25,72	31,45	-44,35	25,72	31,45	-44,35	25,77	31,45	-44,35	0,05	
18	43,14	23,34	-32,07	45,13	19,81	-34,37	45,18	19,81	-34,37	4,68	
19	60,57	15,23	-19,79	61,00	13,45	-23,41	61,05	13,45	-23,41	4,06	

Table H.9 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
20	77,99	7,12	-7,51	77,52	6,31	-11,73	77,57	6,31	-11,73	4,32	**Mean colour difference (5 samples)**
21	95,41	-0,98	4,76	95,31	-0,59	3,30	95,36	-0,59	3,30	1,51	**ΔL^*_{CIELAB} = 2,9**
Mean colour reproduction index: $R^*_{ab,m}$ = 84											

Table H.10 — Colourimetric data of CIE-colours (DIN 33866 no. 4, C6) and series W–N (DIN 33866 no. 3, A2)

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	61,45	17,53	11,74	56,80	12,93	19,60	56,80	12,93	19,60	10,23	
2	60,69	0,08	28,92	55,00	-2,43	35,85	55,00	-2,43	35,85	9,31	
3	62,02	-20,58	44,41	56,74	-24,62	42,51	56,74	-24,62	42,51	6,91	
4	61,20	-33,16	17,07	60,90	-48,15	23,62	60,90	-48,15	23,62	16,36	
5	62,40	-17,47	-8,55	58,17	-20XX	-13,32	58,17	-20XX	-13,32	6,86	
6	61,51	-0,36	-28,39	57,44	0,10	-31,84	57,44	0,10	-31,84	5,36	**Regularity**
7	61,12	20,15	-24,55	56,85	18,29	-25,87	56,85	18,29	-25,87	4,84	**g^* = 79,4**
8	62,77	27,42	-13,63	57,87	27,63	-21,76	57,87	27,63	-21,76	9,49	
9	39,92	58,74	27,99	41,87	38,70	33,27	41,87	38,70	33,27	20,82	**Lightness gamut**
10	81,26	-2,89	71,56	75,56	4,20	74,01	75,56	4,20	74,01	9,43	**f^* = 90,8**
11	52,23	-42,42	13,60	47,15	-47,29	18,53	47,15	-47,29	18,53	8,59	
12	30,57	1,41	-46,47	34,80	1,37	-28,61	34,80	1,37	-28,61	18,35	
13	80,23	11,37	21,04	77,59	15,62	29,57	77,59	15,62	29,57	9,89	**Mean colour difference (14 samples)**
14	40,75	-13,8	24,23	36,07	-18,24	23,81	36,07	-18,24	23,81	6,46	**ΔE^*_{CIELAB} = 10,2**
15	18,01	0,50	-0,45	18,88	-0,06	-2,96	18,88	-0,06	-2,96	2,72	
16	95,41	-0,97	4,76	95,12	-0,58	3,29	95,12	-0,58	3,29	1,55	
17	18,01	0,50	-0,45	18,88	-0,06	-2,96	18,59	-0,06	-2,96	2,64	
18	37,36	0,13	0,84	41,13	-0,54	-2,28	40,84	-0,54	-2,28	4,73	
19	56,71	-0,23	2,15	59,10	-0,76	-1,09	58,81	-0,76	-1,09	3,91	
20	76,06	-0,6	3,45	76,76	-0,78	0,80	76,47	-0,78	0,80	2,69	**Mean colour difference (5 samples)**
21	95,41	-0,97	4,76	95,12	-0,58	3,29	94,83	-0,58	3,29	1,63	**ΔL^*_{CIELAB} = 3,1**
Mean colour reproduction index: $R^*_{ab,m}$ = 62											

Table H.11 — Colourimetric data of 14 CIE and 5 grey colours in pixel image, DIN 33866 no. 4, picture C1

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
1	61,45	17,53	11,74	62,01	1,42	8,41	62,01	1,42	8,41	8,78	
2	60,69	0,08	28,92	62,81	-4,14	24,41	62,81	-4,14	24,41	6,54	
3	62,02	-20,58	44,41	65,47	-29,58	56,54	65,47	-29,58	56,54	15,49	
4	61,20	-33,16	17,07	65,59	-28,55	8,96	65,59	-28,55	8,96	10,31	
5	62,40	-17,47	-8,55	63,63	-4,23	-27,12	63,63	-4,23	-27,12	22,84	

Table H.11 *(continued)*

i	LAB^*_{ref}			LAB^*_{out}			LAB^*_{ouc}			ΔE^*	Specification according to Annex G
6	61,51	-0,36	-28,39	61,65	3,93	-26,69	61,65	3,93	-26,69	4,63	**Regularity**
7	61,12	20,15	-24,55	63,43	15,43	-20,52	63,43	15,43	-20,52	6,62	***g*** = 43,3*
8	62,77	27,42	-13,63	70,22	33,52	-7,18	70,22	33,52	-7,18	11,59	
9	39,92	58,74	27,99	49,61	64,68	27,38	49,61	64,68	27,38	11,38	**Lightness gamut**
10	81,26	-2,89	71,56	87,46	-7,54	99,25	87,46	-7,54	99,25	28,75	***f*** = 79,8*
11	52,23	-42,42	13,60	55,78	-21,39	4,93	55,78	-21,39	4,93	23,02	
12	30,57	1,41	-46,47	45,57	5,17	-38,81	45,57	5,17	-38,81	17,26	
13	80,23	11,37	21,04	80,85	13,33	19,86	80,85	13,33	19,86	2,37	**Mean colour difference (14 samples)**
14	40,75	-13,8	24,23	47,09	-18,99	29,83	47,09	-18,99	29,83	9,92	ΔE^*_{CIELAB} **= 12,8**
15	18,01	0,50	-0,45	27,31	-9,94	4,37	27,31	-9,94	4,37	14,80	
16	95,41	-0,97	4,76	94,38	0,33	3,53	94,38	0,33	3,53	2,07	
17	18,01	0,50	-0,45	27,31	-9,94	4,37	23,18	-9,94	4,37	12,62	
18	37,36	0,13	0,84	37,43	-7,88	4,38	33,30	-7,88	4,38	9,66	
19	56,71	-0,23	2,15	56,85	-2,21	2,12	52,72	-2,21	2,12	4,46	
20	76,06	-0,6	3,45	71,03	3,56	-12,1	66,90	3,56	-12,1	18,53	**Mean colour difference (5 samples)**
21	95,41	-0,97	4,76	94,38	0,33	3,53	90,25	0,33	3,53	5,47	ΔL^*_{CIELAB} **= 10,1**
Mean colour reproduction index: $R^*_{ab,m}$ **= 44**											

Annex I
(informative)

Guideline for ISO-test chart production

This annex includes information for manufacturers who plan to produce ISO-test charts according to this document.

NOTE Similar colour test charts for colour scanner calibration are defined in ISO 12641 by physical layout and with intended colourimetric aim data. The ISO 12641 targets were produced by different manufacturers. The colourimetric data of production: representative measurements of the production and the mean values of the batch are on the website of the manufacturers.

By halftone technique DIN produced the achromatic test chart 1 by an image setter with a resolution of 3 600 dpi on photographic paper. Test charts 2 to 4 were produced using the same image setter (3 600 dpi) which make the printing films for offset printing. The resolutions of all test charts in halftone technique exceed the resolution of actual colour copying machines. Coloured photos have a higher resolution.

Using continuous tone reproduction the Federal Institute for Materials Research and Testing (BAM) of Germany produced four test charts using a digital image setter with a resolution of 300 dpi on photographic colour paper. This resolution corresponds to a 12 × 12 halftone cell (0,083 mm × 0,083 mm). This is smaller than the 22 × 22 halftone cell (0,152 mm × 0,152 mm) used for the production of DIN-test charts in halftone technique (see Annex J).

The ISO-test charts in continuous tone technique are the first test productions which try to correspond in layout and colourimetric data to the specifications of this document. The DIN-test charts in halftone technique produced in the DIN 33866 series differ from this document in the layout of the testing elements but contain nearly the same testing elements.

Table I.1 — ISO-identification and image version code

ISO-identification code and ISO-image version code
The test charts for colour devices show at different positions:
An ISO-identification code on the top right side
An ISO-image version code on the bottom left side
ISO-identification code: (e.g. 19981006-I01)
Abreviation at code-position:
position no. 1 to 4: 1998=year
position no. 5 to 6: 01 to 12=month
position no. 7 to 8: 01 to 31=day
position no. 9: -=(for separation)
position no. 10: I=ISO; (others: e.g. D = DIN)
position no. 11 to 12: 01 to 04=Test chart no. 1 to 4; others
ISO-image version code: (e.g. E1-2CS21)
Abreviation at code-position:
position no. 1: E=English; (others: e.g. G=German; J=Japanese)
position no. 2: 1 to 5=resolutions 192 × 128 to 3 096 × 2 072
position no. 3: - (for separation)
position no. 4: 1 to 4=test chart 1 to 4

Table I.1 *(continued)*

position no. 5: T=text mode; C=colour mode; other modes ...
position no. 6: S=PS-file; D=PDF-file; other files ...
position no. 7 and 8: 11; 21 = Version 11; 21; other versions ...

The ISO-test charts shown in Figures 4 to 7 include an ISO-identification code and an ISO-image version code. These codes are described in Table I.1.

A manufacturer who plans to produce at least one of the four the ISO-test charts shown in Figures 4 to 7 may use the image files which are on the ISO maintenance portal (see Annex M) in the file format PostScript or equivalent for output in format A4. A manufacturer may produce test charts in continuous tone or halftone.

There are other requirements defined in this document for the production of ISO-test charts. The following list may serve as a guideline for production and includes main requirements:

a) a decision shall be taken to produce in halftone or continuous tone technique or both (see 4.6);

b) a decision which test charts to produce and with which material and in which format (see Table 3);

c) for halftone production a manufacturer shall disclose the line screens used for production (see 4.3.6);

d) a decision shall be taken about the manufacturer (company) information part on the ISO-test charts (top middle and top left text on ISO-test charts, compare Figures 4 to 7);

e) for the production of the ISO-test charts 2 and 4 a picture B1 (identical to picture D1) with the requirements (see 4.3.5) is necessary;

f) the layout and the colours to produce are defined in this document (see Figures 1 to 7 Tables 1 and 2, and in Annex H);

g) the manufacturer may try to keep the production differences smaller compared to the “orientation colour differences” of the DIN-production described in Tables 1 and 2, and in Annex H;

h) after production the company may present its results by tables similar to the tables of this document (e.g. Table 1, Table 2, Tables in Annex H and others) on the company and other web servers (see Annex M).

The manufacturers (company) may have some difficulties by imaging the ISO-test charts in PostScript file format or equivalent on the devices for production. The ISO-image files can be used for output on many devices but not all. If the output fails, there are two probable causes:

1) the device and the software are not able to use device-independent *L*a*b**-coordinates (e.g. used in pictures A2, A3, B1, B3, C2, C3, D1, D3);

2) the device and the software are not able to adjust the lines according to device coordinates (e.g. used in pictures A5, A6, C5, C6).

If there are imaging problems the company may try to image the separate picture files. If the picture which produces the problem is known then a work-around may help to image this picture file. If this is successful then in the ISO-image file code this picture may be replaced by the new one.

For the application of this document five representative measurements of the production and the mean values of the batch production are of interest.

Annex J
(informative)

Halftone raster-cell data

This annex includes the information about raster cell threshold data used to produce the DIN-test charts 1 to 4. Copiers sometimes produce different output for colours which appear equal for the human visual system and with equal colourimetric *L*a*b**-data. The scan device within the copier sometimes magnifies the halftone cells (size 0,16 mm × 0,16 mm) by up to a factor 10 and may produce very artificial effects (the real halftone structure and Moiré- effects) not seen by the visual human system. The human visual system cannot resolve details within a halftone cell which the copier can magnify.

Professional image settters and some printers which have included an interpreter of the PostScript-language can fill halftone cells by an operator called "HalftoneType 3". This operator allows putting black points at any *x*- and *y*- location defined by the **device space resolution**. One can send the same PS-file (or equivalent) to an image setter or to some PS-printers (or equivalent) which have included the operator "HalftoneType 3". An image setter with the resolution of 3 600 dpi and a special halftone definition was used for the production of DIN-test charts. Many companies have a secret halftone definition within the software of their PS-devices (or equivalent). It is impossible to repeat production of test charts without knowing the definition of the "HalftoneType 3".

Any company producing test charts in halftone technique shall disclose the "HalftoneType3"-information for the public. The information of the DIN production will serve as example for other productions.

The BAM-PS-image setter with a resolution of 3 600 dpi used for production of DIN-test charts sets points in the raster device space by a distance of 7 µm with a point diameter of 21 µm (three times the raster distance).

A PS-printer (or equivalent) with a resolution of 300 dpi sets points in the raster device space by a distance of 12 × 7 µm = 84 µm with a point diameter of about 3 × 84 µm = 252 µm (three times the raster distance).

Table J.1 shows the PS-file (or equivalent) with a definition of a horizontal "HalftoneType 3"-raster cell. The width and height are 24 × 24, which fills a raster cell of 0,168 mm × 0,168 mm by 24 × 24 points. The threshold data in the raster cell are coded hexadecimal between 00 and F0 by 16 steps. The raster cell is filled according to the 256 steps of the pixel image data. The "HalftoneType 3"-data fill the raster cell "line-oriented" in horizontal direction. This is shown by the output on a PS-printer (or equivalent) with 300 dpi resolution in Figure J.2.

Table J.2 shows the definition of a "HalftoneType 3"-raster cell used for the production of DIN 33866 test charts. The width and height are 22 × 22, which fills a raster cell of 0,154 mm × 0,154 mm by 22 × 22 points. The threshold data in the raster cell are coded hexadecimal between 00 and FC by 64 steps. The raster cell is filled according to the 256 steps of the pixel image data. The "HalftoneType 3"-data fill the raster cell "line-oriented" in vertical direction. This is shown by the output on a PS-printer (or equivalent) with a resolution of 300 dpi in Figure J.2.

The output of a PS-image setter (or equivalent) with a resolution of 3 600 dpi will not allow to detect the orientation of the raster cell in normal visual distance. One can test this by looking at the 16 grey steps of DIN-test chart 1. They appear completely homogeneous.

Within each *EPS*-picture file (or equivalent) there are two *PS*-code lines (or equivalent) describing that there is no halftone type specified. Then the unknown halftone type of the device is used.

```
/Halbt      {

    } def
```