INTERNATIONAL STANDARD

**ISO 12647-3**

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Corrected version
2014-02-15

# Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints —

## Part 3: Coldset offset lithography on newsprint

*Technologie graphique — Contrôle du processus de confection de sélections couleurs tramées, d'épreuves et de tirages —*

*Partie 3: Impression offset sans sécheur sur papier journal*

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 ISO documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO 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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 130, *Graphic technology*.

This third edition cancels and replaces the second edition (ISO 12467-3:2005), which has been revised due to demands from customer experience. The revision introduces grey reproduction and grey balance calculation, a printing condition for standard newsprint, normative $\Delta E^*$ tolerances for primary and secondary colours, one general tone value increase curve, a change in the colouration of magenta, options to monitor the printing characteristics and a general clean up.

ISO 12647 consists of the following parts, under the general title *Graphic technology — Process control for the production of half-tone colour separations, proof and production prints*:

— *Part 1: Parameters and measurement methods*

— *Part 2: Offset lithographic processes*

— *Part 3: Coldset offset lithography on newsprint*

— *Part 4: Publication gravure printing*

— *Part 5: Screen printing*

— *Part 6: Flexographic printing*

— *Part 7: Proofing processes working directly from digital data*

— *Part 8: Validation print processes working directly from digital data*

This corrected version of ISO 12647-3:2013 incorporates the following corrections:

— *in 4.2.8, a formatting error in the second paragraph has been corrected;*

— *in* Annex F*, the word "might" has been changed to "may" in the first sentence of the first paragraph.*

# Introduction

When producing a half-tone colour reproduction it is important that the colour separator and printer have previously specified a minimum set of parameters that uniquely define the visual characteristics and other technical properties of the planned print product. Such an agreement enables the correct production of suitable separations (without recourse to “trial-and-error”).

For more information on the technical background refer to ISO 12647-1.

It is the purpose of this part of ISO 12647 to list and explain the minimum set of process parameters required to uniquely define the visual characteristics and related technical properties of a half-tone production print produced by coldset offset lithography on newsprint from a set of half-tone separation data.

It is a further purpose of this part of ISO 12647 to list values or sets of values of the primary parameters specified in ISO 12647-1 and related technical properties of a half-tone newspaper print produced from a set of half-tone colour separation data. When deemed useful, secondary parameters are also recommended for specification.

Provisions for flexographic printing can be found in informative Annex D.

# Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints —

# Part 3: Coldset offset lithography on newsprint

## 1 Scope

This part of ISO 12647 specifies a number of process parameters and their values to be applied when producing colour separations and printing forms for newspaper single or four-colour printing. The parameters and values are chosen in consideration of the process, covering the process stages: "colour separation", "making of the printing formed", "OK print or proof" and "production printing".

This part of ISO 12647 is intended to enhance communication between printers, publishers and advertisers and to make print buyers aware of the expected printed result in advance, enabling them to plan accordingly. This part of ISO 12647 defines tolerances, allowing for objective quality evaluations and raising the competitiveness of newspapers compared to other media.

This part of ISO 12647 is applicable:

— to coldset offset production printing on newsprint that use colour separation data;

— by analogy to press printing from printing surfaces produced by direct imaging;

— to line screens and non-periodic screens, parameters given can be applied by analogy.

Although this International Standard does not specify process control for flexographic printing, digital printing systems or letterpress production printing, the production aims defined by this International Standard may be applied when these printing technologies are used and where the printing result is intended to be similar to that produced by coldset offset lithography.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-3, *Photography and graphic technology — Density measurements — Part 3: Spectral conditions*

ISO 2846-2, *Graphic technology — Colour and transparency of printing ink sets for four-colour printing — Part 2: Coldset offset lithographic printing*

ISO/TS 10128, *Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data*

ISO 12647-1:2013, *Graphic technology — Process control for the production of half-tone colour separations, proof and production prints — Part 1: Parameters and measurement methods*

ISO 12647-7, *Graphic technology — Process control for the production of half-tone colour separations, proof and production prints — Part 7: Proofing processes working directly from digital data*

ISO 13655:2009, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

# 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12647-1 and the following apply.

**3.1**
**coldset offset lithography**
method of offset lithographic printing (conventional or waterless) where the inks set "dry" primarily by absorption into the print substrate

**3.2**
**digital proof print**
digital print of high colour accuracy, useable as reliable visual colour reference for printing, and as a part of a commercial agreement as defined in ISO 12647-7

# 4 Requirements

## 4.1 General

Digital data files delivered for printing should be accompanied by a digital proof print, a press proof print, or an OK print from a previous print run. An OK-print from a previous print run (or a press proof), being in conformance with the requirements for an OK-print stipulated in 4.3 and stored under appropriate conditions, shall be used as the reference for the OK-print.

Digital proofs using an electronic display and digital proof prints shall not be used to gather measurement values to be used as reference in this part of ISO 12647.

NOTE On-press proof prints are test prints of the data files on a printing press. Most proofs are digital proof prints. However, for colour or content critical work sometimes there is a request for press proof prints using the same setup as the production print.

## 4.2 Data files and printing forms

### 4.2.1 Data files

Data delivered for printing shall be in the colour formats CMYK or three components and should be exchanged in PDF/X data formats as defined in ISO 15930 (all parts).

The intended printing condition shall be indicated in case of PDF/X data exchange. In case of PDF/X the mechanisms provided by the specified data format shall be used. In case of other data formats, a printing condition description, a characterization data set, or an International Colour Consortium (ICC) output profile shall be communicated.

Data other than CMYK shall be defined by colorimetric description using an ICC profile or other mechanism. An ICC CMYK output profile should be included. The rendering intent to be used with the output profile shall be communicated.

If the characterization data or ICC output profile provided conflict with the printing conditions defined in this part of ISO 12647 one of the methods defined in ISO/TS 10128 shall be used for data adjustment toward the printing conditions defined in this International Standard.

Checks are recommended to ensure the conformance of the data with the requirements of the printing standard.

### 4.2.2 Printing form quality

The resolution of the plate setter shall be set to a minimum frequency of 393cm$^{-1}$ and should be set to a minimum frequency of 500cm$^{-1}$.

The deviation of similar tone values of the data file in different areas of the printing form shall not exceed ± 1,5 tone value %.

### 4.2.3 Screen frequency (periodic screens)

For all half-tone elements, the screen frequency should be between 40 $cm^{-1}$ and 54 $cm^{-1}$. Within the same print product the screen ruling shall be the same for colour and black-and-white printing. If other screen rulings are used the tone value increase shall be adjusted such that it agrees with Table 7 and Figure 3.

NOTE 1 Older Raster Image Processor (RIP) software might not be able to produce the requested screen angle at the requested screen ruling exactly. This is why with computer-generated screens, the parameters screen ruling and screen angle can be varied slightly.

NOTE 2 Screen frequencies are often required or given in lpi (lines per inch). To convert between lines per centimetre and lines per inch a conversion factor of 2,54 should be used. For example the requirement of $40^{-1}$ and $54^{-1}$ given in lpi will read as follows (rounded to commonly used integral numbers): for all half-tone elements, the screen frequency should be between 100 lpi and 140 lpi.

### 4.2.4 Screen dot size (non-periodic screens)

The screen dot size for non-periodic screens should be 40 µm ± 10 µm, depending on substrate requirements.

### 4.2.5 Screen angle (periodic screens)

For half-tone dots without a principal axis, the nominal difference between the screen angles for cyan, magenta and black should be 30°, with the screen angle of yellow separated at 15° from another colour. The screen angle of the dominant colour should be 45°. The dominant colour is defined as the one that contains most of the image information compared to the others. For typical newspaper applications the dominant colour will be black. Refer to Figure 1 for an example of a screen angle combination for a screen with a principal axis and with black as the dominant colour.

For half-tone dots with a principal axis (elliptical half-tone dot shape), the nominal difference between screen angles for cyan, magenta and black should be 60°, with the screen angle of yellow at 0° and 15° off from the next screen angle. The screen angle of the dominant colour should be 45° or 135°.

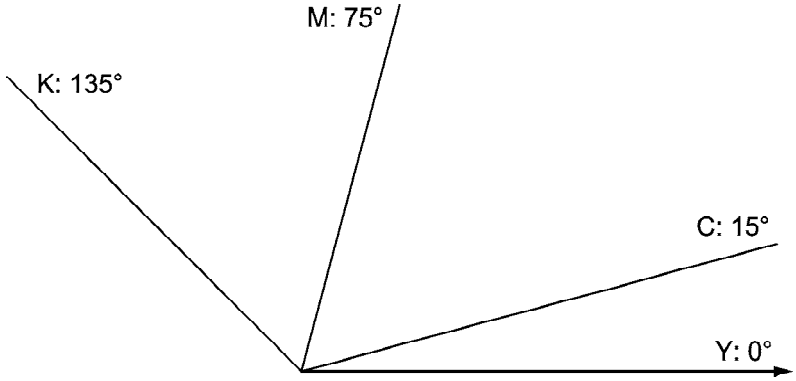



**Figure 1 — Example of a screen angle combination for a screen with a principal axis and with black as the dominant colour**

NOTE The dominant colour is defined as that which contains most of the image information compared to the others. For typical newspaper colour separations with GCR the dominant colour will be black.

### 4.2.6 Dot shape and its relationship to tone value (periodic screens)

For periodic screens, elliptical half-tone dot shapes should be used. For half-tone dots with a principal axis, the first link-up should occur no lower than at 40 % tone value (data) and the second link-up no higher than at 60 % tone value (data).

### 4.2.7 Tone value sum

Unless otherwise specified, the tone value sum should not exceed 220 % and shall not exceed 240 %. Where the maximum tone value sum approaches this limit, the tone value of black should be at least 90 %.

NOTE Any colour that is reproduced using all three chromatic process inks can be thought of as having a neutral component. This is defined by the lowest tone value and its grey balance equivalents of the other two inks. It is possible to replace all or some of the neutral component by black ink. Under colour removal (UCR) limits the tone value sum by replacing chromatic colour ink with black ink in the neutral shadows. Grey component replacement (GCR) replaces chromatic colour ink with black ink in the entire colour space. GCR is recommended for newspaper colour separations because it reduces colour variations caused by poor ink trapping, back transfer, set-off during the print run, and eases registration.

### 4.2.8 Grey reproduction and grey balance

The grey balance in printing can effectively be used for print quality control in newspaper print production. Since typical newsprint does not have a neutral but a yellowish colour, the following calculation method of grey balance in printing should be applied for coldset printing.

The tone values of cyan, magenta and yellow leading to a visually neutral grey should be calculated from the standard printing condition or actual printing condition or the associated profiles by the following formula describing the grey reproduction $(L^*, a^*, b^*)$ with respect to a given paper colour $\left(L^*_{paper}, a^*_{paper}, b^*_{paper}\right)$ and CMY-overprint $\left(L^*_{cmy}\right)$ for each $L^*$ in the range from $L^*_{paper}$ to $L^*_{cmy}$:

$$a^* = a^*_{paper} \times \left[1 - 0{,}85 \times \left(L^*_{paper} - L^*\right) / \left(L^*_{paper} - L^*_{cmy}\right)\right]$$

$$b^* = b^*_{paper} \times \left[1 - 0{,}85 \times \left(L^*_{paper} - L^*\right) / \left(L^*_{paper} - L^*_{cmy}\right)\right]$$

NOTE 1 A single grey balance condition is usually not sufficient to ensure an achromatic colour for all print substrates and printing inks that may be used with a given printing process. Therefore the grey balance has to be determined for each printing condition separately based on a well-defined grey reproduction.

NOTE 2 The grey balance of a given printing process can be used for process calibration and process control as long as the tolerances for tone value increase and mid-tone spread as defined in Table 7 are not exceeded.

NOTE 3 The multiplying factor of 0,85 represents a visual adaptation of 85 % to the paper white.

NOTE 4 See Annex B for more information on specifying grey balance values.

## 4.3 Proof or production print

### 4.3.1 General

A printing condition for coldset offset printing shall be described by a print substrate, a colorant description, a screening description, an ink set, and a printing sequence. In all printing conditions described in this part of ISO 12647, the ink set shall be according to ISO 2846-2 and the printing sequence shall be Cyan – Magenta – Yellow – Black or Black - Cyan – Magenta – Yellow. See specifications

of printing conditions for typical print substrates in Table 1. See Annex E for information on additional printing conditions.

NOTE 1 Characterization data are based on CMYK which is generally the preferred printing sequence.

**Table 1 — Printing conditions for typical print substrates**

| Printing condition | Print substrate description (Table 2) | Colorant description (Table 3) | Screening description | | | |
|---|---|---|---|---|---|---|
| | | | Periodic screens | | Non-periodic screens | |
| | | | TVI | Frequency | TVI | Spot size |
| Offset | Standard newsprint | SNP | 26 % | 40 $cm^{-1}$ to 54 $cm^{-1}$ | 26 % | 40 µm |

Colorimetric characterization data, as specified in ISO 12642, contain all the data to be specified in accordance with 4.3.2.1, 4.3.2.3 and 4.3.4.1

NOTE 2 Additional printing conditions based on commonly used print substrates may follow the scheme described in this and the following clauses.

NOTE 3 Table 1 does not define a paper specification but is intended to give an indication of a reference on which the target colours can be reached.

### 4.3.2 Visual characteristics of image components

#### 4.3.2.1 Print substrate colour

The production print substrate shall conform to the *L**, *a**, *b** values and tolerances specified in Table 2.

A digital proof on an electronic display or a digital proof print according to ISO 12647-7 produced directly from digital data should be used as a visual reference. Press proof printing should be carried out using a substrate, which matches as closely as possible all of the properties listed in Table 2. For off-press proofing, the requirements defined in ISO 12647-7 apply. A paper selection in the light of a close simulation with respect to the aim values defined in Table 2 ensures an easy simulation of the associated colorant description and therefore the visual appearance.

**Table 2 — CIELAB coordinates, mass-per-area, gloss, and CIE whiteness for typical print substrates**

| Parameters | Print substrate | | |
|---|---|---|---|
| Characteristic | Standard newsprint | | |
| Type of surface | Uncoated | | |
| Mass-per-area (informative only) [a] | g/m$^2$ | | |
| | 40 to 52 (45) | | |
| Brightness C (informative only) [b] | 1 | | |
| | 55 to 80 | | |
| Gloss (informative only) [c] | 1 | | |
| | < 5 | | |
| **Colour** [d] | | | |
| **Parameters** | **L*** | **a*** | **b*** |
| White backing (informative only) | 85 | 1 | 5 |
| Black backing | 82 | 0 | 3 |
| Tolerance | ±4 | ±2 | ±2 |

[a, b, c] Informative only. A bandwidth of typical values (product properties) applies.

[a] Mass-per-area: values in brackets pertain to the respective colour coordinates (influence of white or black backing).

[b] Measurement is in accordance with ISO 2470-1, ISO brightness.

[c] Measurement is in accordance with ISO 8254-1, TAPPI method.

[d] Measurement is in accordance with ISO 13655-D50 illuminant, 2° observer, 45:0 or 0:45 geometry. Experts of the paper making industry usually use different measuring conditions. They measure according ISO 2469: C illuminant 2 observer, d/0° geometry, opaque pad of newsprint backing. Under ISO 2469 conditions and according ISO 5631-1 the following colour values correspond to the colour coordinates of this table: L* 83,4 / a* -0,3 / b* 5.

NOTE 1 Annex F gives more information on handling differences in paper colour.

NOTE 2 Table 2 does not define a paper specification but is intended to give an indication of a reference on which the target colours can be reached.

#### 4.3.2.2 Print substrate gloss

The gloss of the print substrate used for press proof printing should be a close simulation to that of the production print substrate. Matching the gloss of the print substrate is also important for digital proof printing stipulated in ISO 12647-7.

NOTE Information on gloss values is given in Table 2.

#### 4.3.2.3 Ink set colours (colorant description)

The CIELAB colour coordinates *L**, *a**, *b** of the process colour solids CMYK and the secondary colour overprints Red (M+Y), Green (C+Y), Blue (C+M) on the OK print shall agree with the aim values specified in Table 3 within the deviation tolerances specified in Tables 5 and 6. Table 4 specifies the aim values of ink colours on newsprint measured on white backing and is informative only.

The variability of the process colour solids CMYK during the production run is restricted by the following condition. For at least 68 % of the prints, the colour differences from the OK print shall not exceed the appropriate variation tolerances specified in Tables 5 and 6.

At least 68 % of the print production shall follow the conditions expressed in 4.3.2.3, 4.3.4.2 and 4.3.5.

**Table 3 — CIELAB L*, a*, b* aim values of ink colours on newsprint black backing measurements (normative)**

| Colour | L* | a* | b* |
|---|---|---|---|
| Unit | 1 | 1 | 1 |
| Cyan | 57 | −23 | −27 |
| Magenta | 54 | 44 | −1 |
| Yellow | 78 | −3 | 58 |
| Black | 36 | 1 | 4 |
| Cyan + yellow | 53 | −34 | 17 |
| Cyan + magenta | 41 | 7 | −22 |
| Magenta + yellow | 52 | 41 | 25 |
| Cyan + magenta + yellow | 40 | 0 | 1 |
| Four-colour black; (K = 100 %, C = 52 %, M = 44 %, Y = 44 %) | 34 | 1 | 2 |
| These values are aim values for the (dry) print product delivered to the customer. Measurements should be made using M1, in accordance with ISO 13655-D50 illuminant, 2° observer, 45:0 or 0:45 geometry. Values for four-colour black are based on colour sequence CMYK in printing. | | | |

**Table 4 — CIELAB L*, a*, b* aim values of ink colours on newsprint white backing measurements (informative only)**

| Colour | L* | a* | b* |
|---|---|---|---|
| Unit | 1 | 1 | 1 |
| Cyan | 59 | −24 | −27 |
| Magenta | 56 | 48 | 1 |
| Yellow | 80 | −1 | 62 |
| Black | 37 | 1 | 4 |
| Cyan + yellow | 55 | −34 | 17 |
| Cyan + magenta | 42 | 7 | −23 |
| Magenta + yellow | 54 | 45 | 26 |
| Cyan + magenta + yellow | 40 | 0 | 0 |
| Four-colour black; (K = 100 %, C = 52 %, M = 44 %, Y = 44 %) | 35 | 0 | 2 |
| These values are aim values for the (dry) print product delivered to the customer. Measurements should be made using M1, in accordance with ISO 13655-D50 illuminant, 2° observer, 45:0 or 0:45 geometry. Values for four-colour black are based on colour sequence CMYK in printing. | | | |

NOTE 1 The secondary colours red, green, blue can vary depending on conditions that include the mechanics of the press, the surface characteristics of the print substrate and the rheological and transparency properties of the inks. Thus, conformance of the primaries C, M, Y to specifications is not sufficient for the conformance of the secondaries to the values given in Tables 3 and 4.

NOTE 2 The values in Table 3 and Table 4 relate to printing with ink sets in accordance with ISO 2846-2; they were derived from press runs in the field.

NOTE 3 The distribution of CIELAB values is not Gaussian but skewed. For reasons of consistency, the variation tolerance is defined here as the upper limit for 68 % of the production copies. This is in analogy with a Gaussian distribution where 68 % are within plus or minus one standard deviation from the mean.

NOTE 4 As a secondary reference, reflection densities for the process colours as measured with two different densitometer types are provided in Annex A. In[3] and[6] a reference to a complete list of X, Y, Z and CIELAB values of a complete ISO 12642 target is given.

Figure 2 shows the CIELAB *L**, *a**, *b** black backing aim values of ink colours on newsprint (SNP).

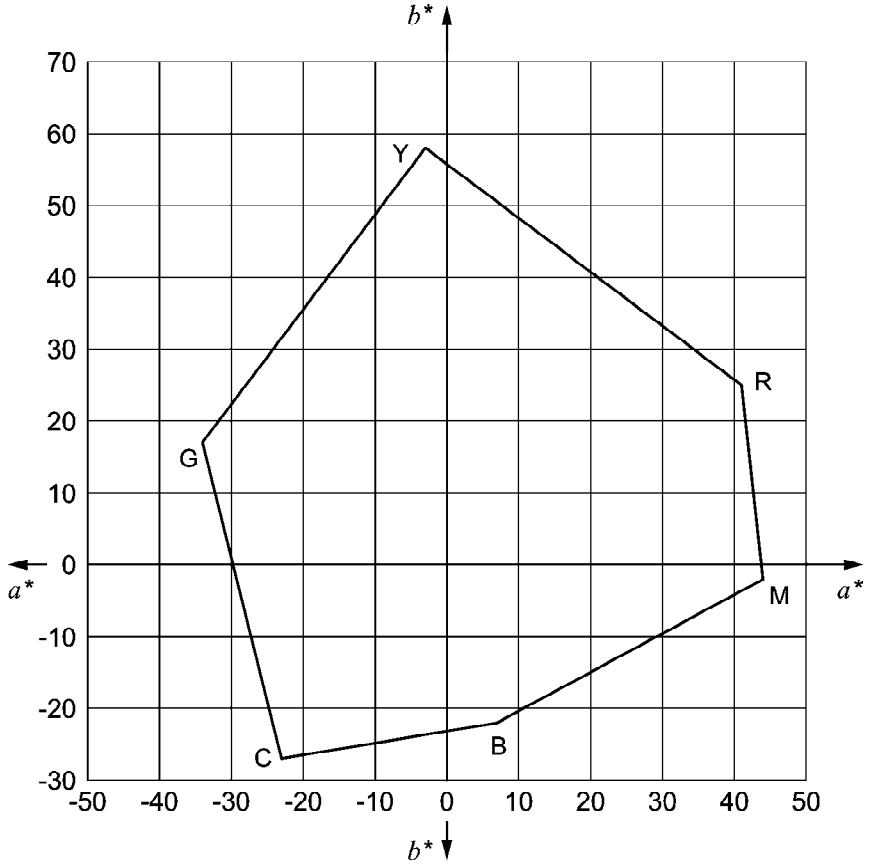



**Figure 2 — CIELAB *L**, *a**, *b** aim values (bb) of ink colours on newsprint**

The variation tolerance is defined as the upper limit for 68 % of the production copies.

**Table 5 — CIELAB Δ*E** tolerances for the solids of the process colour**

| Colour deviation | Black | Cyan | Magenta | Yellow |
|---|---|---|---|---|
| Unit | 1 | 1 | 1 | 1 |
| Deviation tolerance DE76, normative | 5 | 5 | 5 | 5 |
| Variation tolerance DE76, normative | 4 | 4 | 4 | 5 |
| Deviation tolerance DE2000, informative only | 5 | 3,5 | 3,5 | 3,5 |
| Variation tolerance DE2000, informative only | 4 | 2,8 | 2,8 | 3,5 |
| NOTE Deviation and variation tolerances are defined in ISO 12647-1. | | | | |

**Table 6 — CIELAB Δ*E** tolerances for the secondary colour overprints**

| Colour deviation | M+Y | C+Y | C+M |
|---|---|---|---|
| Unit | 1 | 1 | 1 |
| Deviation tolerance DE76, normative | 8 | 8 | 8 |
| Variation tolerance DE76, normative | 7 | 7 | 7 |
| Deviation tolerance DE2000, informative only | 5,6 | 5,6 | 5,6 |
| Variation tolerance DE2000, informative only | 4,9 | 4,9 | 4,9 |
| NOTE Deviation and variation tolerances are defined in ISO 12647-1. | | | |

### 4.3.3 Tone value reproduction limits

Half-tone dot patterns within the following tone value limits in the digital data file should transfer on to the print in a consistent and uniform manner:

3 % to 95 % for offset printing.

No significant image parts should rely on tone values outside of the above tone value reproduction limits.

### 4.3.4 Tone value increase

#### 4.3.4.1 Aim values

The tone value increase for the production run and press proof printing are specified in Table 7 and Figure 3 within the tolerances specified in Table 9. The specifications for proofing shall be in accordance with ISO 12647-7.

The values taken from the polynomial equation below shall take precedence.

The tone values for printing forms shall be adjusted such that, for all primary colours, the tone value increase from data to paper conforms to the curve specified in Table 7.

NOTE 1 The tone value increase from data to the printed result varies considerably depending on the press and the printing conditions. It is recommended to set-up a newspaper Computer-to-Plate (CTP) system (RIP, plate setter and processor) in such a way that the target tone value increase of Table 7 and Figure 3 can be achieved on the printed sheet.

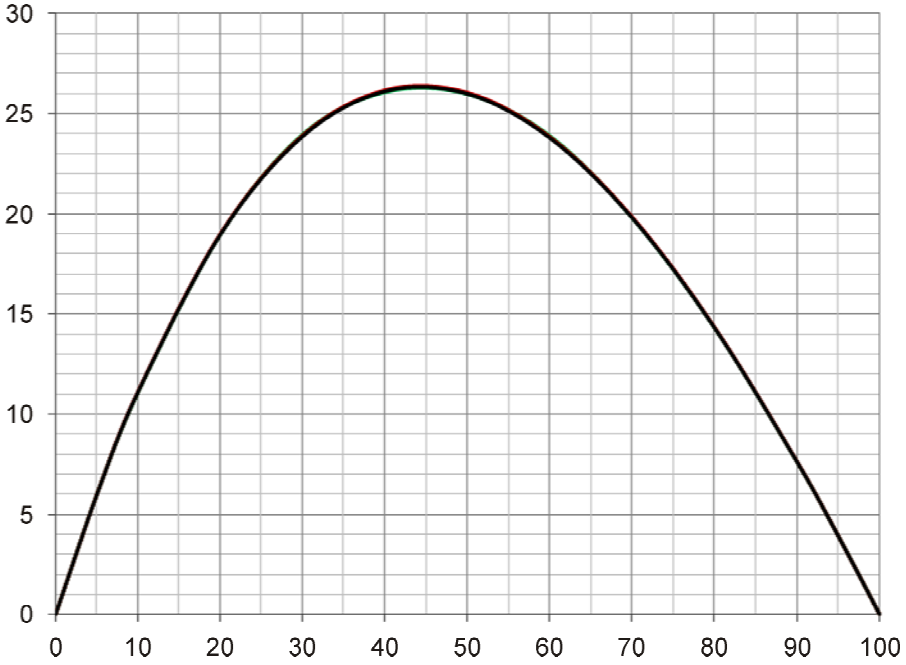
NOTE 2 The values given in Table 7 refer to densitometric measurement according to ISO 5-3 in a control strip, with an ISO Status E response, without polarization. For process control measurements on the wet sheet, however, density should be measured according ISO Status E using a polarization filter.

NOTE 3 When using standard inks the measurement of TVI using Status T produces results that are close to those produced when using Status E measurements.

**Table 7 — Tone value increase measured on production prints**

Values in percent

| Reference tone value (data) | Tone value increase |
|---|---|
| 0 | 0 |
| 5 | 6,0 |
| 10 | 11,1 |
| 20 | 19,0 |
| 30 | 23,9 |
| 40 | 26,2 |
| 50 | 26,0 |
| 60 | 23,8 |
| 70 | 19,8 |
| 80 | 14,3 |
| 90 | 7,6 |
| 95 | 3,9 |
| 100 | 0,0 |




**Key**

X reference tone value in percent

Y tone value increase in percent

26 % curve

**Figure 3 — Tone value increase curve according to Table 7**

For process calibration and control purposes, it is sometimes necessary to calculate the tone value or tone value increase on a print for additional tone values. For this a fourth order polynomial function describing the curves in Figure 3 is given as follows:

$$TVI(x)=100*\left(a*x^4+b*x^3+c*x^2+d*x\right)$$

where

*TVI* is the tone value increase as a percentage value;

*a, b, c, d* are the coefficients of the polynomial;

*x* is the tone value normalized between 0 and 1; *x* = TV/100;

*TV* is the tone value in % ranging from 0 to 100.

The polynomial coefficients are given in Table 8.

**Table 8 — Polynomial coefficients for tone value increase curve in Figure 3**

Unit: 1

| Polynomial coefficient | Tone value increase |
|---|---|
| | 26 % curve |
| a | 0,0049 |
| b | 0,4793 |
| c | –1,7688 |
| d | 1,2847 |

#### 4.3.4.2 Tone value and mid-tone spread tolerances

The deviation of the tone value increase and mid-tone spread of an OK print from the specified aim values shall not exceed the deviation tolerances specified in Table 9.

For production printing, the TVI differences between a production copy and the aim values shall not exceed the pertinent variation tolerances specified in Table 9.

The mid-tone spread (variation of tone values between all colours) shall not exceed the values listed in Table 9.

For production printing, for at least 68 % of the prints, the TVI differences between a production copy and the OK print shall not exceed the pertinent variation tolerances specified in Table 9. The mid-tone spread (variation of tone values between chromatic colours) of at least 68 % of production printing samples shall not exceed the values listed in Table 9.

At least 68 % of the print production shall follow the conditions expressed in 4.3.2.3, 4.3.4.2 and 4.3.5.

**Table 9 — Tone value increase tolerances and maximum mid-tone spread for OK print and production printing**

Values in percent

| Tone value (data) of control patch | Deviation tolerance | Variation tolerance |
|---|---|---|
| | OK print | Production print |
| < 30 | 4 | 4 |
| 30 to 60 | 5 | 5 |
| > 60 | 4 | 4 |
| Maximum mid-tone spread | 6 | 6 |

An ISO 12647-3 conforming print run shall conform to the requirements of a production print in a way that for a minimum of 68 % out of randomly selected individual print samples spread across the production run all normative criteria are fulfilled.

NOTE 1 The number of print samples will depend on the print run length to be specified elsewhere.

NOTE 2 The values in Table 9 refer to measurements on a control strip with a screen ruling to be the same as the subject.

NOTE 3 Percentage tolerances are calculated by subtracting the aim value from the measured value.

### 4.3.5 Tolerance for image positioning

The colour register shall not exceed 0,20 mm as largest deviation (hypotenuse) between two colours measured in lateral and circumferential direction.

At least 68 % of the print production shall follow the conditions expressed in 4.3.2.3, 4.3.4.2 and 4.3.5.

NOTE Suitable tools for colour register measurement are, for example, the Vernier scale or electronic measurement equipment

## 5 Test methods

Refer to ISO 12647-1 test methods and note the following additional requirements.

### 5.1 Computation of CIELAB colour coordinates and CIELAB colour differences

Both colour and density measurements shall be made in conformance with ISO 13655 and ISO 5-3. The computation of CIELAB colour coordinates and CIELAB colour differences shall be made in conformance with ISO 12647-1 and ISO 13655. The densitometry measurement shall be according to ISO 5-3, with an ISO Status E or T response, with or without polarization.

### 5.2 Control strip

On each print a control strip conforming to ISO 12647-1:2013, 5.2, may be used. Additional control strips, usually placed within printing direction, may be used. For evaluation of colour accuracy and monitoring of the degree to which the solid colour aims and TVI aims are achieved, one of the methods described in Annex C should be used.

# Annex A
(informative)

# Densities of ink set colours

For the correct reproduction of images, the CIE $L^*a^*b^*$ values of the inks on the print substrate are important. For control purposes, the associated reflection density is often used.

Reflection density values are valid only for a specific combination of ink and print substrate. This requires the individual determination of specific reflection densities for the used combination of printing ink and print substrate.

The following reflection densities of the process colour solids on newsprint on black backing serve as approximation:

a) ISO Status E, relative density, polarized:

— ink colours: Cyan D = 0,90; Magenta D = 0,90; Yellow D = 0,90; Black D = 1,10;

— substrate: D = 0,0.

b) ISO Status T, absolute density, unpolarized:

— ink colours: Cyan D = 0,88; Magenta D = 0,89; Yellow D = 0,85; Black D = 1,05;

— substrate: Cyan D = 0,23; Magenta D = 0,24; Yellow D = 0,27; Black D = 0,22.

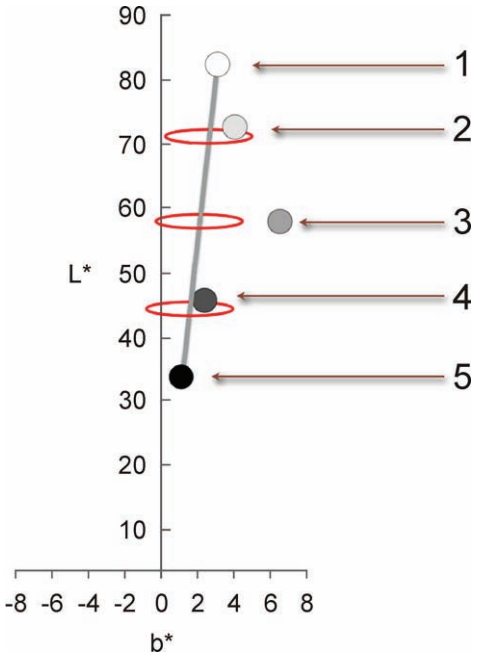
# Annex B
(informative)

# Grey reproduction and grey balance

From the grey balance curve, it is possible to calculate grey balance and grey reproduction values for process calibration and process control purposes. The pointer (short name) "IFRA26" to the characterization data sets can be found on the ICC website, www.color.org. The file contains *X, Y, Z* and *L*, a*, b** values for an ISO 12642 target with 928 (IFRA26S.txt) or 1485 patches (IFRA26L.txt). With the aid of the characterization data sets the grey balance conditions are accessible.

Older versions of this part of ISO 12647 provide two practical definitions for grey: a colour having the same *a** and *b** CIELAB values as the print substrate and a colour having the same *a** and *b** CIELAB values as a half-tone tint of similar *L** value printed with black ink. The second definition is particularly useful in the mid-tone and shadow, whereas the first is best applied to highlight tones. So it seems useful to define a mixture of both or something similar for a single grey definition.

The proposed grey definition in 4.2.8, a colour having *a** and *b** CIELAB values ranging from paper white *a** and *b** to less chromatic values for darker grey, is a good compromise between an easy implementation and a more complex colour appearance matching method. For any *L** between the paper white and the lowest achievable neutral *L** for a three-component grey, it is possible to calculate *a** and *b** values. Figure B.1 illustrates the grey axis reference and measured grey colours in comparison to the reference colour values.




**Key**

1 paper
2 light grey, here within the tolerance
3 medium grey, here outside the tolerance
4 shadow, here within the tolerance
5 $G_{max}$ achieved with maximum tone value sum

**Figure B.1 — Example grey axis reference**

Figure B.2 shows the calculated $a^*$ and $b^*$ values using the formulas in 4.2.8 along with paper value from Table 2 and CMY overprint value from Table 3. The reference grey balance is taken to be a linearly proportional distribution of the CIELAB chroma values ($a^*$ and $b^*$) relative to the change in the $L^*$ value over the range determined through measurement of the two end points: the unprinted paper and the three colour overprint.

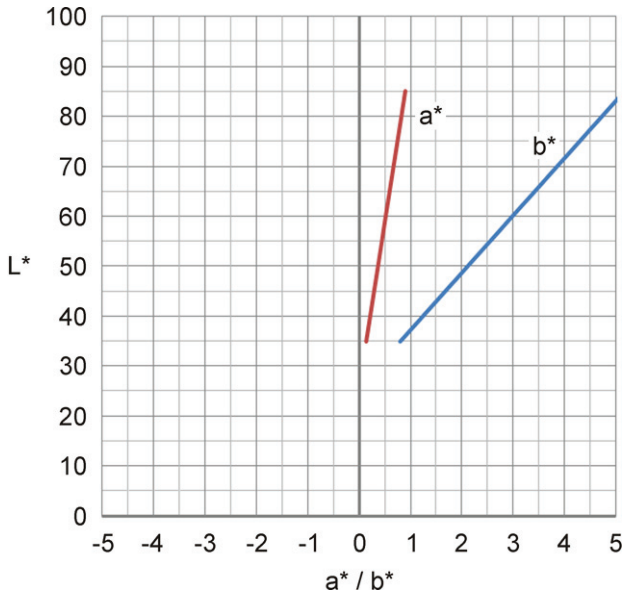



**Figure B.2 — Example grey reproduction curve for a* and b***

From a fully characterized printing process, it is possible to calculate the corresponding grey balance values. The grey balance curve for a typical reference printing process with periodic screens on standard newsprint is shown in Figure B.3.

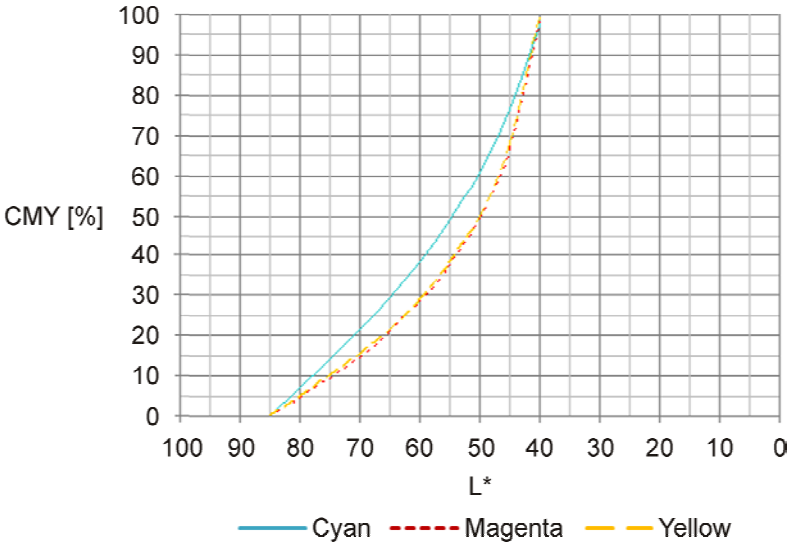



**Figure B.3 — Example grey balance curve**

Tolerance values for grey reproduction can be calculated from a characterized printing process based on the tone value increase tolerances and maximum mid-tone spread for proof and production printing

by introducing a chroma difference $\Delta C_h$ between the desired grey reproduction chroma $(a^*_1, b^*_1)$ and the measured chroma $(a^*_2, b^*_2)$ of a grey balance control patch:

$$\Delta C_h^* = \left[ (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2 \right]^{1/2}$$

**Table B.1 — Grey balance evaluation chart and grey reproduction values**

| Grey balance | | | | | | | |
|---|---|---|---|---|---|---|---|
| Colour | Paper | Light grey | Medium | Shadow | Dark grey | $G_{max}$ | $G_{CMY}$ |
| Unit | % | % | % | % | % | % | % |
| C | - | 10,0 | 30,0 | 50,0 | 75,0 | 87,0 | 100 |
| M | - | 6,5 | 21,1 | 38,6 | 64,0 | 76,6 | 100 |
| Y | - | 6,9 | 21,4 | 38,9 | 62,9 | 76,4 | 100 |

| Grey reproduction values (black backing) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| L* | 82 | 75,2 | 62,5 | 52,7 | 44,4 | 42,1 | 39,6 |
| a* | 0 | 0 | 0 | 0 | 0 | 0 | - 0,2 |
| b* | 3 | 2,8 | 2,0 | 1,3 | 0,4 | 0,1 | - 0,1 |

| Grey reproduction values (white backing) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| L* | 85 | 77,9 | 64,7 | 54,4 | 45,6 | 43,1 | 40,4 |
| a* | 1 | 0,8 | 0,6 | 0,4 | 0,3 | 0,2 | 0,1 |
| b* | 5 | 4,6 | 3,4 | 2,4 | 1,2 | 0,8 | 0,4 |

| Chroma tolerances | | | | | | | |
|---|---|---|---|---|---|---|---|
| Unit | - | 1 | 1 | 1 | 1 | 1 | - |
| ΔCh | - | 3,4 | 3,4 | 2,4 | 1,5 | 1,5 | - |

It should be noted that the data of Table B.1, including the tolerance values for highlight, mid-tone, and shadow, are valid for the standard coldset printing process on standard newsprint only and may differ for other print substrates or printing processes.

For other printing conditions as described in this part of ISO 12647, it is recommended to create an individual characterization data set. From this data set grey balance and grey reproduction data and special control aids as well as profiles for colour separation can be derived. Printing on newsprint with different paper whites need slightly modified grey reproduction values. This modification can be done with the linear scaling method as described in ISO 13655:2009, A.4.

NOTE 1 GCMY (Grey 100/100/100) is a virtual value, taken from the ICC-profile and is only used as an operator when using the grey balance calculation formula as described in 4.2.8

NOTE 2 The characterization data set "IFRA26" is an example of a data set that characterizes the typical coldset offset newspaper printing process on standard newsprint using standard newsinks. The characterization data set "IFRA26" has been generated by averaging measured data from more than 200 test print runs on production presses from international sources. Generic ICC newspaper printing profiles that have been created on the basis of "IFRA26" data have proven over years to be robust and well suited to optimize full colour newspaper printing.

# Annex C
(informative)

# Process control targets

## C.1 Background

Verifying the conformance of a newspaper press run to aim reference printing conditions or characterization data presents a unique problem. Typical newspaper printing is web based and the final product is delivered sheeted but untrimmed. This usually eliminates the use of control bars that are trimmed off during final production that is typical of most printing. This annex offers several options that can be, and have been, used successfully to monitor the printing characteristics either directly or indirectly for the purpose of process control and/or process verification. This listing is not exhaustive and this subject is one of continued study within the newspaper printing industry. The various options are discussed in C.2 to C.5.

## C.2 Traditional control strips

In some markets traditional control strips can and are printed either in the gutter or on a lower edge of some pages. Where this is considered acceptable, this is the ideal solution. Many target variations are available from industry groups and they can be created locally depending on the geometry needed or desired. Most have as a minimum the three chromatic solids and a black solid as well as mid-tones.

## C.3 Use of an ad-type test element

It is possible to print test elements that are either incorporated into advertisements or resemble advertisements that include the key elements needed to monitor the printing characteristics needed to verify process control. These can be printed on selected sheets that verify the performance of individual printing stations. One variation of this is the incorporation of colour solids and tints as part of the section banners in the various sections of the printed piece.

## C.4 Use of image-based image content

Most advertising and image areas will have areas of near neutral three-colour overprints and/or solids or near solids of individual colours. While these must be selected on a publication and version basis, they can provide effective monitoring of the printing performance. Comparison of the values in the data file and the colorimetric data of the characterization data being used as the printing aim allow colour deviations to be determined along with potential sources of these deviations.

## C.5 Printing test pages

It is always possible, but costly and less desirable, to print a test element using plates made using the standard plate making setup used for production work. These test pages can be printed before or after the production press run and can carry far more test elements that any other procedure. However, in addition to the added cost (paper, production time, etc.) there is the added need to correlate this test printing to the production printing to allow the results of the test sheets to be extrapolated to apply to the production work.

# Annex D
(informative)

# Flexographic newspaper printing

## D.1 General

This part of ISO 12647 has historically been developed for one printing condition, namely coldset offset printing. However newspaper is printed not only by means of coldset offset but also by flexographic printing. Since the revision of ISO 12647-6 does not provide process control provisions for flexography, the following information provides recommendations for selected criteria and can be used as guidance.

## D.2 Tone value reproduction limits

Half-tone dot patterns within the following tone value limits in the digital data file should transfer on to the print in a consistent and uniform manner:

5 % to 90 % for flexo printing.

No significant image parts should rely on tone values outside of the above tone value reproduction limits.

## D.3 Screen frequency (periodic screens)

For flexographic newspaper printing the typical screen frequency is between 38 $cm^{-1}$ and 48 $cm^{-1}$.

## D.4 Printing conditions

A printing condition for flexographic printing should be communicated by a print substrate description, a colorant description, a screening description, an ink set and a printing sequence. A typical printing condition is shown in Table D.1. The TVI curve labelled “26 %” is defined in Table 7.

**Table D.1 — Printing conditions for typical print substrates**

| Printing condition | Print substrate description (Table 2) | Colorant description (Table 3) | Screening description | | | |
|---|---|---|---|---|---|---|
| | | | Periodic screens | | Non-periodic screens | |
| | | | TVI | Frequency | TVI | Spot size |
| Flexographic newspaper printing | Standard newsprint | SNP | 26 % | 38 $cm^{-1}$ to 48 $cm^{-1}$ | 26 % | 40 µm |

# Annex E
(informative)

# Additional printing conditions

## E.1 General

This part of ISO 12647 has historically been developed for one printing condition, namely printing on standard newsprint (SNP). However it is more and more common that newspaper printers print on improved newsprint stock by using coldset printing. This annex provides guidelines for an additional printing condition (APC) that reflects coldset printing on improved newsprint.

The additional printing is shown in Table E.1. The ink set should be according to ISO 2846-2 and the printing sequence should be Cyan – Magenta – Yellow – Black.

**Table E.1 — Standard printing conditions for typical print substrates**

| Additional printing condition | Print substrate description (Table E.2) | Colorant description (Table E.3) | Screening description | | | |
|---|---|---|---|---|---|---|
| | | | Periodic screens | | Non-periodic screens | |
| | | | TVI curve (Table E.4) | Frequency | TVI curve | Spot size |
| APC1 | PS1 | CD1 | C | 40 $cm^{-1}$ to 60 $cm^{-1}$ | E | 35 µm |

## E.2 Print substrate colour

Typical paper characteristics are defined, for information only, in Table E.2. Production paper comprising a coloration differing from the aim values in Table E.2 may not have similar values as shown in established data characterisations. In this case, a dedicated substrate description using the attributes shown in Table E.2 and an associated set of characterization data are recommended.

**Table E.2 — CIELAB coordinates, mass-per-area, and CIE whiteness for print substrates (informative)**

| Characteristic | PS1 | | |
|---|---|---|---|
| Type of paper | Improved newsprint | | |
| Mass-per-area [a] | g/m² | | |
| | 40 to 56 (49) | | |
| CIE whiteness [b] | % | | |
| | 40 to 80 | | |
| Gloss [c] | % | | |
| | 10 to 35 | | |
| Colour [d] | Coordinates | | |
| | L* | a* | b* |
| White backing | 89 | 0 | 3 |
| Black backing | 86 | −1 | 2 |
| Tolerance | ±3 | ±2 | ±2 |
| Fluorescence [e] | faint | | |

a, b, c, e Informative only. A bandwidth of typical values (product properties).

a Mass-per-area: Values in brackets pertain to the respective colour coordinates (influence of white or black backing).

b Whiteness measurement is in accordance with ISO 11475, outdoor illumination conditions. Note that this single point measurement value is (among other variables) based on D65 viewing conditions. D50 is the standard viewing condition used when printing. Whiteness values should be used for guidance only.

c Measurement is in accordance with ISO 8254-1, TAPPI method.

d Measurement is in accordance with ISO 13655-D50 illuminant, 2° observer, 0:45 or 45:0 geometry. Measurements can be made using M0 or M1.

e Typical delta D65 brightness UV/$UV_{ex}$ evaluated as per ISO 2470-2, and information as recommended in ISO 15397. This indicates the sensitivity of a print to blue shift when compared with a proof under Standard light condition D50 according to ISO 3664. Usual limits for Fluorescence: faint (>0), low (>4), moderate (>8), high (>14).

## E.3 Ink set colours

The CIELAB colour coordinates *L**, *a**, *b** of the process colour solids CMYK and the secondary colour overprints Red (M+Y), Green (C+Y), Blue (C+M) on the OK print should agree with the black backing aim values specified in Table E.3 within the deviation tolerances specified in Tables 5 and 6. The variability of the process colour solids CMYK during the production run should be restricted by the following condition. For at least 68 % of the prints, the colour differences from the OK print should not exceed the appropriate variation tolerances specified in Tables 5 and 6.

The CIELAB colour coordinates *L**, *a**, *b** of the process colour solids CMYK and the secondary colour overprints Red (M+Y), Green (C+Y), Blue (C+M) measured on white backing are shown in Table E.4.

**Table E.3 — CIELAB L*, a*, b* aim values of ink colours on newsprint black backing measurements**

| Colours | L* | a* | b* |
|---|---|---|---|
| Unit | 1 | 1 | 1 |
| Cyan | 57 | −23 | −34 |
| Magenta | 54 | 49 | −1 |
| Yellow | 80 | −3 | 64 |
| Black | 36 | 1 | 4 |
| Cyan + yellow | 51 | −35 | 12 |
| Cyan + magenta | 40 | 6 | −24 |
| Magenta + yellow | 51 | 46 | 24 |
| Cyan + magenta + yellow | 38 | 0 | 0 |
| NOTE These values are aim values for the (dry) print product delivered to the customer. Measurement is in accordance with ISO 13655-D50 illuminant, 2° observer, 45:0 or 0:45 geometry. Values for three-colour black are based on colour sequence CMYK in printing. | | | |

**Table E.4 — CIELAB L*, a*, b* aim values of ink colours on newsprint White backing measurements**

| Colours | L* | a* | b* |
|---|---|---|---|
| Unit | 1 | 1 | 1 |
| Cyan | 58 | −24 | −35 |
| Magenta | 56 | 52 | 0 |
| Yellow | 83 | −2 | 68 |
| Black | 36 | 2 | 5 |
| Cyan + yellow | 53 | −38 | 13 |
| Cyan + magenta | 41 | 7 | −27 |
| Magenta + yellow | 53 | 50 | 26 |
| Cyan + magenta + yellow | 39 | 0 | 0 |
| NOTE These values are aim values for the (dry) print product delivered to the customer. Measurement is in accordance with ISO 13655-D50 illuminant, 2° observer, 45:0 or 0:45 geometry. Values for three-colour black are based on colour sequence CMYK in printing. | | | |

## E.4 Tone value increase

The tone value increase for the production run and on press proof printing are specified in Table E.1 within the tolerances specified in Table 7.

# Annex F
(informative)

# Handling differences in paper colour

In some cases the paper selected for production does not match the reference exactly and in these cases it may be necessary to adjust some of the printing aim values. There is currently no reliable method to determine whether such an adjustment is necessary; furthermore there is no universally agreed method for making these adjustments. For small differences in paper colour no correction is necessary and aim values and tolerances defined in this International Standard should be used with no modification. For larger differences some adjustment might be necessary and this annex provides some information about one method that has had some success. There are other methods in use today, some of which might produce more accurate results or are easier to use. These other methods might be preferred by some users.

When necessary, the substrate correction should be applied to the values in Tables 2, 3, 5 and 6 and these corrected values should be used for process control. Printing tolerances should not be modified.

One conversion method that produces reasonable results is based on the observation that if the differences of CIE *X*, CIE *Y*, and CIE *Z* between measurements made of identical images on substrates having different colours are plotted versus CIE *X*, CIE *Y*, and CIE *Z* for measurements on either substrate, the best fit result is approximately a straight line. This leads, as an approximation, to a linear conversion.

For CIE *X*:

$$X_2 = X_1 * (1 + C) - X_{\min} * C \tag{F.1}$$

with

$$C = (X_{s2} - X_{s1}) / (X_{s1} - X_{\min}) \tag{F.2}$$

where

$X_1$ is the measured value of *X* of a coloured patch on substrate 1;

$X_2$ is the estimated value of *X* of an equivalent coloured patch on substrate 2;

$C$ is a constant;

$X_{s1}$ is the measured value of *X* of substrate 1;

$X_{s2}$ is the measured value of *X* of substrate 2;

$X_{min}$ is the minimum value of *X* for any patch printed on substrate 1.

Conversion of CIE *Y* and CIE *Z* is accomplished in an analogous manner and new CIE *L**, *a** and *b** CIELAB values are computed.

This colorimetric conversion method is referred to as the CIE tristimulus correction method.

NOTE This is similar to the ICC method referred to as substrate relative colorimetric transforms and is identical to that method where the Black Points of both substrates have CIE *X* = CIE *Y* = CIE *Z* = 0,0.

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