INTERNATIONAL STANDARD

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Graphic technology — Colour and transparency of printing ink sets for four-colour printing —

Part 1: Sheet-fed and heat-set web offset lithographic printing

Technologie graphique — Couleur et transparence des gammes d'encre d'impression en quadrichromie —

Partie 1: Impression lithographique offset sur feuilles et à bobines

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Foreword

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This third edition cancels and replaces the second edition (ISO 2846-1:2006), which has been technically revised.

The main change compared to the previous edition is as follows:

— Annex A has been revised in order to replace the reference substrate and references to other ISO standards have been updated.

A list of all parts in the ISO 2846 series can be found on the ISO website.

Introduction

This document defines the colour and transparency of lithographic printing inks. Different sets of inks (both for proof and production printing) conforming to this document will produce a similar colour when printed on the same substrate at the appropriate film thickness. This enables colour separations for offset-lithographic printing to be based on known colour references and simplifies the task of consistently printing the same images in multiple printing sites.

It should be noted that the colorimetric characteristics specified can only be obtained when the inks are printed on the reference substrate. However, the similarity of two inks on a reference substrate generally ensures similarity on another substrate, and it is this similarity that has enabled the development of industry specifications or standards such as ISO 12647-2[1], which specifies the colour of these inks on other substrates.

The APCO II/II reference substrate, used for many years, is no longer available and has been replaced by a new developed reference substrate, C2846, with properties which are for the purpose of this document similar to the old substrate. Where the new substrate is used for other purposes than specified in this document, new references may have to be determined.

The colour specified in the previous edition of this document was based on extensive measurements of commercial ink sets made in Europe, Japan and the USA. A working group of ISO/TC 130 process control and material experts examined data sets from various countries at the time that edition was prepared and found that a single set of colour coordinates could adequately represent all three proposals within reasonable tolerances. In addition, they found that the transparency of various inks could also be adequately represented by a new method of evaluation. A review undertaken prior to the revision of this edition suggested that there had been little change in the colour and transparency of the inks commercially available and that the characteristics specified in this document could be reconfirmed.

Graphic technology — Colour and transparency of printing ink sets for four-colour printing —

Part 1: Sheet-fed and heat-set web offset lithographic printing

1 Scope

This document specifies the colour and transparency characteristics that are to be met by each ink in a process colour ink set intended for proof and production printing using offset lithography. The specified printing conditions (which use a laboratory printability tester), the defined substrate and a method for testing to ensure conformance are also defined. Characteristics are specified for inks used for sheet-fed, heat-set web and radiation-curing processes.

This document does not apply to fluorescent inks and it does not specify pigments (or spectral characteristics — except informatively) in order not to preclude developments which may enable different pigment combinations to be used advantageously while still achieving the colorimetric requirements specified in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 535, *Paper and board — Determination of water absorptiveness — Cobb method*

ISO 536, *Paper and board — Determination of grammage*

ISO 2144, *Paper, board and pulps — Determination of residue (ash) on ignition at 900 °C*

ISO 2834-1, *Graphic technology — Laboratory preparation of test prints — Part 1: Paste inks*

ISO 6588-1, *Paper, board and pulps — Determination of pH of aqueous extracts — Part 1: Cold extraction*

ISO 8254-1, *Paper and board — Measurement of specular gloss — Part 1: 75 degree gloss with a converging beam, TAPPI method*

ISO 8791-4, *Paper and board — Determination of roughness/smoothness (air leak methods) — Part 4: Print-surf method*

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 following terms and definitions apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
0°:45° or 45°:0°
measurement geometry of a spectrophotometer in conformance with ISO 13655 geometry 0°:45° or 45°:0°

3.2
8°:di or di:8°
hemispherical diffuse geometry, specular component included, with either 8° incidence (influx) (8°:di) or 8° exitance (efflux) (di:8°)

Note 1 to entry: The measurement geometry of a spectrophotometer not in conformance with ISO 13655.

3.3
ink
printing ink
composite material containing colorants, functional components, vehicle and additives

Note 1 to entry: In most cases, applied as a fluid to a substrate by a printing process and setting or drying by either physical (evaporation) and/or chemical (polymerizations, e.g. oxidation, radiation induced, or other) processes to form an image for decorative, informative or technical purposes.

3.4
standard ink
process ink
ink (3.3) intended for four-colour printing which, when printed on the reference substrate and within the applicable range of ink film thicknesses, complies to the colorimetric and transparency specifications of this document

3.5
transparency
ability of an *ink* (3.3) film to transmit light

Note 1 to entry: It is generally expressed as some measure of the unwanted scattering.

3.6
transparency value
T

reciprocal of the slope of the regression line between *ink* (3.3) film thickness and colour difference for overprints of chromatic inks over black substrate

4 Test method

4.1 Procedure

Colorimetric conformance shall be verified by printing each ink on the reference substrate, described in Annex A, at a range of ink film thicknesses. The colours of the resultant test prints shall be measured and the colour difference determined between the sample and the pertinent value given in Table 1. If at least one of these samples has a smaller colour difference than that specified in 5.2, the ink conforms colorimetrically to this document.

NOTE It is often more convenient to determine the colorimetric conformance of an ink graphically. This is achieved by calculating the colour difference (ΔE^*_{ab}) from the values in Table 1 for each of the prints made and plotting this against the ink film thickness. The ink conforms if the resultant curve shows a pronounced minimum which is below the ΔE^*_{ab} value specified in Table 1. (See Annex B for further information.)

Transparency value, *T*, shall be determined by printing each of the chromatic process inks on to a black substrate meeting the requirements of 4.2.2, at a range of ink film thicknesses. The colour difference, ΔE^*_{ab}, is determined for each sample between the overprinted and unprinted black substrate. The gradient of the linear regression of ink film thickness against colour difference shall be determined. An ink conforms to the transparency requirements of this document if the reciprocal of the gradient is negative, or greater than the value specified. (See Annex B for further information.)

The gradient of the regression equation may be determined directly from the data obtained. However, it is recommended that it be obtained from a graphical plot of the values of ΔE^*_{ab} against ink film thickness. Such a plot enables any unexpected characteristics of the data to be easily visualized. (See Annex B for further information.)

If one or more printed samples of each ink conform to the colorimetric values within the tolerances specified at an ink film within the thickness range specified, and the ink also meets the transparency criteria, that ink can be said to comply to this document.

4.2 Test print preparation

4.2.1 Prints for colorimetric evaluation

For each of the inks to be evaluated, several test prints shall be made, each produced at a different ink film thickness, according to the conditions specified in ISO 2834-1.

They shall be made on the reference substrate specified in Annex A. The range of ink film thicknesses produced shall encompass the range specified for the process for which the ink is intended. (See 5.4.)

4.2.2 Prints for transparency evaluation

The test prints for transparency evaluation shall be produced by printing the inks to be tested on a black substrate such that a minimum of four samples is achieved, each with a different ink film thickness. The printing shall be undertaken as described in ISO 2834-1. The range of ink film thicknesses achieved shall not exceed that defined in 5.4.

NOTE Test prints with ink film thicknesses below 0,7 µm can cause errors in the transparency evaluation.

The black substrate shall have a lightness, L^*, less than 6 when determined in accordance with ISO 13655:2009, M0, M1 or M2 (with the exception that a white backing shall be used when measuring the print; see 4.3). The black substrate shall have a gloss of (80 ± 5) GU measured according to ISO 8254-1.

Although in principle, it is possible for the user to produce themselves the black substrate by printing, it is difficult to ensure that the lightness is sufficiently low without adversely affecting the gloss and printing properties of the substrate. It is usually preferable to use a black substrate or a substrate pre-printed commercially. However, if it is necessary to print the black, the recommendations given in Annex B should be followed. Appropriate substrates are the contrast card or the contrast strip[1)].

4.2.3 Drying of test prints

Prior to colour measurement, all samples shall be thoroughly dried. Inks formulated for oxidation drying shall be left for at least 24 h, those formulated for radiation curing shall be dried with an appropriate radiation source within the appropriate time and energy and heat-set inks shall be heat dried with appropriate drying equipment.

NOTE Be aware that the appropriate time for radiation curing inks can be down to parts of a second only.

4.3 Colour measurement procedures

Test prints shall be measured in accordance with ISO 13655 using white backing. Measurement condition M1 should be used. M0 or M2 may be used and should not give difference in results.

Conforming to ISO 13655:2009, M1 means that samples shall be measured spectrally, with a 0°:45° or 45°:0° geometry instrument, and for calculation of CIELAB colour values, the CIE 1931 (2°) standard

1) Comparison test strips CT2846 with contrast band from IGT Testing Systems (www.igt.nl), NL-1316 BX Almere, The Netherlands. These products are examples 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 of these products.

colorimetric observer data are used together with CIE standard illuminant D50 including calibrated UV level; see Reference [3]. Where spectral data are obtained at wavelength intervals greater than 5 nm, the weighting functions for the standard colorimetric observer specified in ISO 13655 shall be used.

For calculating the colour difference from the reference values, the CIE 1976 colour difference, ΔE^*_{ab}, shall be used.

NOTE For the comparison of measurements, it is useful to record the following details:

— the ink designation and batch number;

— the ink layer thicknesses;

— the substrate used;

— the printability tester used and the settings used on the tester (speed, force, printing form);

— environmental conditions (lab temperature and relative humidity);

— spectrophotometer used;

— any deviations from this document.

5 Requirements for colour, transparency and ink film thickness range

5.1 General

For an ink to conform to this document, it shall meet the specifications for colour defined in 5.2, and the specification for transparency defined in 5.3, at an ink film thickness within the range specified in 5.4.

5.2 Colorimetric values

When printed in accordance with Clause 4, an ink shall produce a colour that falls within the defined colour difference tolerances, ΔE^*_{ab}, from the L^*, a^*, b^* values specified in Table 1.

Table 1 — Colorimetric values for M1, 0°:45° geometry, illuminant D50, 2° observer

Ink	CIELAB values[a]				Tolerances[a]			
	L^*	a^*	b^*	ΔE^*_{ab}	ΔE_{00}[b]	Δa^*	Δb^*	L^*
Yellow	91,0	−5,1	95,0	4,0	2,8	—	—	—
Magenta	50,0	76,0	−3,0	4,0	2,8	—	—	—
Cyan	57,0	−39,2	−46,0	4,0	2,8	—	—	—
Black	18,0	0,8	0,0	—	—	±1,5	±3,0	18,0[c]

[a] Parameters L^*, a^*, b^*, ΔE^*_{ab}, $\Delta a^*$and Δb^* are defined in ISO 13655:2009, M1.

[b] ΔE_{00} values are presented for information only.

[c] For black, there is no symmetrical tolerance for L^* but an upper limit.

NOTE 1 Typical spectral data for inks conforming to this document are provided in Annex C. Reference spectral data for 8°:di or di:8° geometry are also included in Annex C.

NOTE 2 Reference data for tristimulus values calculated from the CIE 1931 (2°) standard colorimetric observer, together with CIE illuminant D65, are included in Annex D for both 8°:di or di:8° and 0°:45°. Tristimulus data for 8°:di or di:8° geometry and illuminant D50 are also included in Annex D.

5.3 Transparency characteristics

When printed in accordance with Clause 4, an ink shall produce a transparency value, T, greater than that specified in Table 2.

