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

Part 1:

**Sheet-fed and heat-set web offset
lithographic printing**

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

Partie 1. Impression lithographique offset sur feuilles et à chaud

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 2846-1 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 2846-1:1997), of which subclauses 4.2 and 5.2 and Annex D have been technically revised. Some very minor changes have been made for the purposes of simplification, and an effort has been made to clarify and update this document in some places. Clauses 4 and 5 have been interchanged with each other. In addition, the test-print preparation requirements have been deleted and referenced to ISO 2834-1. Annex B, describing the history of the development of the colour standard, has been removed and Annex E relettered to Annex B.

ISO 2846 consists of the following parts, under the general title *Graphic technology — Colour and transparency of printing ink sets for four-colour printing*:

- *Part 1: Sheet-fed and heat-set web offset lithographic printing*
- *Part 2: Coldset offset lithographic printing*
- *Part 3: Publication gravure printing*
- *Part 4: Screen printing*
- *Part 5: Flexographic printing*

Introduction

This part of ISO 2846 defines the colour and transparency of lithographic printing inks. Different sets of inks (both for proof and production printing) conforming to this part of ISO 2846 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 industry specifications or standards such as ISO 12647-2^[1], which specifies the colour of these inks on other substrates, to be developed.

The colour specified in the previous edition of this part of ISO 2846 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 part of ISO 2846 could be reconfirmed.

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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

1 Scope

This part of ISO 2846 specifies the colour and transparency characteristics that have 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 part of ISO 2846 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 part of ISO 2846.

2 Normative references (standards.iteh.ai)

The following referenced documents are indispensable for the application 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° 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, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ANSI CGATS.5:2003, *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.

3.1

standard ink

ink 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 part of ISO 2846

3.2

transparency

ability of an ink film to transmit light

NOTE It is generally expressed as some measure of the unwanted scattering.

3.3

transparency measurement value

T

reciprocal of the slope of the regression line between ink 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 part of ISO 2846.

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 on colour difference shall be determined. An ink conforms to the transparency requirements of this part of ISO 2846 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 visualised. (See Annex B for further information.)

If one or more printed samples of each ink conform to the colorimetric values within the tolerances specified, and the ink also meets the transparency criteria, that ink can be said to comply to this part of ISO 2846.

4.2 Test print preparation

4.2.1 Prints for colorimetric evaluation

For each of the inks to be evaluated, a number of 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 that 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 should at least cover that defined in 5.4.

The black substrate shall have a lightness, L^* , less than 6 when determined in accordance with ISO 13655 (with the exception that a white backing shall be used when measuring the print; see 4.3).

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 dry. 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 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, except that a white backing which is in conformance with ANSI CGATS.5 shall be used.

Conforming to ISO 13655 means that samples shall be measured spectrally, with a $0^\circ:45^\circ$ or 45° geometry instrument, and for calculation of CIELAB colour values the CIE 1931 (2°) standard colorimetric observer data is used together with CIE standard illuminant D50; see Reference [3]. Where spectral data is obtained at wavelength intervals greater than 5 nm, the weighting functions for the standard colorimetric observer specified in ISO 13655 are used.

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

NOTE 1 ISO 13655 is currently under revision and it is the intent of the committee to add a white backing condition identical to that of ANSI CGATS.5.

NOTE 2 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 forme);
- environmental conditions (lab temperature and relative humidity);
- spectrophotometer used;
- any deviations from this part of ISO 2846.

1) Leneta paper or card (No. 105 C) which may be purchased from Leneta Corp., Mahwah, NJ, USA; contrast strip: comparison test strips Ka APCO C with contrast band (several widths) which may be purchased from IGT Testing Systems, Amsterdam, The Netherlands. These products are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 2846 and does not constitute an endorsement by ISO of these products.

5 Requirements for colour, transparency and ink film thickness range

5.1 General

For an ink to conform to this part of ISO 2846 it shall meet the specifications for colour defined in 5.2, and the specification for transparency defined in 5.3, at some 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 0°:45°a geometry, illuminant D50, 2° observer

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

^a Parameters L^* , a^* , b^* , ΔE_{ab}^* , Δa^* and Δb^* are defined in ISO 13655.
^b For black, there is no symmetrical tolerance for L^* but an upper limit.

NOTE 1 Typical spectral data for inks conforming to this part of ISO 2846 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°a. 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, T , value greater than that specified in Table 2.

Table 2 — Transparency requirements

Ink	Transparency, T
Yellow	0,08
Magenta	0,12
Cyan	0,20

For highly transparent inks (usually cyan) the slope of the regression line may be zero or negative. In such a situation the transparency value is considered to be approaching infinity and therefore meets the specification.

NOTE For information concerning transparency evaluation using instruments with different geometry, see B.3.2.

5.4 Ink film thickness

The range of ink film thicknesses within which a standard ink shall conform is provided in Table 3 for the different ink drying processes specified in this part of ISO 2846.

Table 3 — Range of ink film thicknesses in micrometres

Drying mechanism	Ink			
	Cyan	Magenta	Yellow	Black
Drying by oxidation/setting	0,7 to 1,1	0,7 to 1,1	0,7 to 1,1	0,7 to 1,3
Radiation curing	0,7 to 1,3	0,7 to 1,3	0,7 to 1,3	0,9 to 1,3
Heat-set web	0,7 to 1,3	0,7 to 1,3	0,7 to 1,3	0,9 to 1,3

Annex A (normative)

Reference substrate

For the purposes of this part of ISO 2846, a lightfast, gloss-coated, wood-free paper free of optical brightener shall be used as the printing substrate, the characteristics of which shall be as follows:

Colorimetric values

Specification: CIELAB values
 $L^* = 95,5 \pm 2,0$
 $a^* = -0,4 \pm 1,0$
 $b^* = 4,7 \pm 1,5$

Method: ISO 13655 (see 4.3)

Water absorptiveness

Specification: 2 g/m² to 5 g/m² after 10 s

Method: ISO 535

Gloss

Specification: 70 % to 80 %

Method: ISO 8254-1

Mass per area

Specification: (150 ± 3) g/m²

Method: ISO 536

Ash content

Specification: 20 % to 30 %

Method: ISO 2144

pH

Specification: 8 to 10

Method: ISO 6588-1

Roughness

Specification: 0,9 µm to 1,1 µm at a pressure of 1 N/mm²

Method: ISO 8791-4

NOTE In practice there has been only one supplier of this material and it has become the de facto standard. This material is the gloss-coated, woodfree paper Phoenix Imperial APCO II/III from Scheufelen, D-73250 Lenningen, Germany.²⁾

2) This information is given for the convenience of users of this part of ISO 2846 and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.