INTERNATIONAL STANDARD

ISO 2846-2

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

Part 2: Coldset offset lithographic printing

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

Partie 2: Impression lithographique offset rotatif coldset

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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 2846-2 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 2846-2:2000), of which Clauses 4 and 5 have been technically revised and the colorimetric properties of the inks were adjusted to be compatible with actual commercial requirements and to the process standard ISO 12647-3[1]. Details for test print preparation, which are now specified in ISO 2834-1, have been deleted.

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

The initial draft of ISO 2846-2 was prepared by ISO/TC 130 for materials and process control. They examined the colorimetric properties of commercial coldset web offset inks from around the world and found that a single set of colour coordinates could adequately represent these, within reasonable tolerances. Since the initial publication of this part of ISO 2846, additional coordination between the various national bodies participating in ISO/TC 130 has suggested that some minor refinements of the colorimetric aims would make them more compatible with actual commercial printing requirements and to the process standard ISO 12647-3 [1].

This part of ISO 2846 will allow printers to obtain sets of process inks from various sources which will produce a similar colour when printed on the reference substrate at the appropriate film thickness. This will allow colour separations for coldset web offset printing to be based on known colour standards. The colorimetric characteristics specified in this part of ISO 2846 may only be obtained when the inks are printed on the reference substrate. However, similarity of two inks on the reference substrate will ensure similarity on another substrate.

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

Part 2: Coldset offset lithographic printing

1 Scope

This part of ISO 2846 specifies the colour and transparency to be produced by inks intended for four-colour coldset web offset printing when printed under specified conditions on a printability tester. It also describes the test method to ensure conformance.

This part of ISO 2846 is not applicable to fluorescent inks and does not specify pigments (or spectral reflectance) so as not to preclude the use of future suitable pigment combinations and still claim compliance with its colorimetric requirements.

2 Normative references

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 536, *Paper and board — Determination of grammage*

ISO 2471, *Paper and board — Determination of opacity (paper backing) — Diffuse reflectance method*

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

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
coldset printing
web offset printing without accelerated drying

NOTE Ink sets by absorption into the substrate.

3.2
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

3.3
primary colours
colours of individual prints from yellow, magenta and cyan inks

NOTE If the prints are produced as specified in this part of ISO 2846 and conform to the colorimetric characteristics specified, they are standard primary colours.

3.4
transparency
ability of an ink film to transmit light, generally expressed as some measure of the unwanted scattering

3.5
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

4 Test method

4.1 Principle

Each ink is printed on the reference substrate described in Annex A at a range of ink film thicknesses. The colours which result are measured colorimetrically.

Transparency is evaluated by printing each of the three primary colours on a black substrate at a range of film thicknesses. The CIELAB colour difference is determined for each sample, between the printed and unprinted black, and the linear regression coefficient (slope of the regression line) between ink film thickness and colour difference is calculated for each colour.

For a detailed description of procedures, together with examples, see the informative Annex B.

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 using a printability tester, each produced at a different ink film thickness in accordance with the conditions specified in ISO 2834-1. They shall be made on the reference substrate as specified in Annex A. The sample material shall be kept in the dark under standard conditions of 23 °C and 50 % RH. The range of ink film thicknesses produced shall encompass that specified in 5.3. In cases where the approximate ink film thickness is known to result in the closest match of the target colorimetric values, a minimum of three prints shall be made. Otherwise, a minimum number of five prints should be made covering the full range of specified film thicknesses.

4.2.2 Prints for transparency evaluation

Test prints for transparency evaluation shall be produced by printing the inks to be tested on a black substrate using a printability tester. Measurements of the CIELAB values of the black substrate shall be made prior to overprinting. The black shall have a lightness (L^*) less than 30 when determined in accordance with ISO 13655.

The ink to be tested shall then be printed on the black substrate[1)] in accordance with the conditions specified in ISO 2834-1, such that a range of samples, each with a different ink film thickness, is achieved. The range should approximate that defined in 5.3.

4.2.3 Setting of test prints

Prior to colour measurement, all printed samples shall be left for at least 12 h to enable setting of the ink.

4.2.4 Colour measurement procedure

Test prints shall be measured in accordance with ISO 13655 with the exception that a white backing, in accordance with ANSI/CGATS.5:2003, shall be used.

NOTE 1 The requirements for white backing given in ANSI/CGATS.5:2003 are consistent with the future revision of ISO 13655.

NOTE 2 The colorimetric values are related to the measurement procedure specified in ISO 13655. This means that the samples are measured spectrally, with a 0°:45° (0°:45° indicates the relationship between incident light and reflected light measurement angles) or 45°:0° geometry instrument. For the calculation of CIELAB values and for the colour difference, the CIE 1931 (2°) standard colorimetric observer data are used together with CIE standard illuminant D50.

5 Requirements for colour, transparency and ink film thickness range

5.1 Colour

For an ink to conform to this part of ISO 2846, it shall meet the following requirements:

a) when printed as specified in 4.2.1, at some ink film thickness within the range specified in 5.3, the ink shall meet the colorimetric target value and tolerance specified in Table 1;

b) it shall meet the transparency requirements specified in 5.2.

NOTE Typical spectral data for inks conforming to this part of ISO 2846 are provided in Annex C.

Table 1 — Colorimetric values

Ink	CIELAB values			Tolerances			
	L^*	a^*	b^*	ΔE^*_{ab}	L^*	Δa^*	Δb^*
Yellow	80,4 (78,0)	−1,4 (−3,0)	61,6 (58,0)	4,0 (4,0)			
Magenta	55,5 (54,0)	47,6 (44,0)	0,7 (−2,0)	4,0 (4,0)			
Cyan	59,1 (57,0)	−23,9 (−23,0)	−27,1 (−27,0)	4,0 (4,0)			
Black	36,8 (36,0)	1,5 (1,0)	4,5 (4,0)		⩽ 36,8 [a] (⩽ 36,0 [a])	± 1,0 (± 1,0)	± 2,0 (± 2,0)
Values in brackets pertain to measurement on black backing in accordance with ISO 13655 and are given for information only.							
[a] This means that for black there is no symmetrical tolerance for L^* but an upper limit.							

1) Contact the ISO/TC 130 Secretariat (DIN) for the source of a suitable substrate.

5.2 Transparency characteristics

To meet the specification for transparency an ink shall produce a value greater than that specified in Table 2 when determined by the principles and procedures outlined in 4.1 and 4.2.2.

Table 2 — Transparency

Ink colour	Transparency measurement value T
Yellow	0,1
Magenta	0,2
Cyan	0,3

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

For further information concerning transparency evaluation, see B.2.

5.3 Ink film thickness range

The range of ink film thickness, within which a standard ink for coldset lithographic printing shall conform to the colorimetric values specified in 5.1, is 0,7 µm to 1,3 µm.

Annex A
(normative)

Reference substrate

The characteristics of the reference substrate shall be the following.

a) Colour

The colour values for the reference substrate are given based on white backing. In addition, black backing values are given for information.

	white backing	**black backing**
CIELAB values	$L^* = 85{,}2 \pm 4{,}0$	$L^* = 82{,}0 \pm 4{,}0$
	$a^* = 0{,}9 \pm 2{,}0$	$a^* = 0{,}0 \pm 2{,}0$
	$b^* = 5{,}2 \pm 2{,}0$	$b^* = 3{,}0 \pm 2{,}0$
Method:	ISO 13655 (0°:45°, D50, 2°, with the exception that white backing shall be used, as described in 4.2.4).	

b) Mass per area

Specification: $(48{,}8 \pm 2)$ g/m^2

Method: ISO 536

c) Opacity

Specification: > 94 %

Method: ISO 2471

d) Roughness

Specification: $(3{,}4 \pm 0{,}2)$ µm at a pressure of 1 MPa

Method: ISO 8791-4

Annex B
(informative)

Detailed explanation of testing including examples

B.1 Colorimetric verification

In order to evaluate whether an ink complies with this part of ISO 2846, it is necessary to print a number of samples, each of known ink film thickness, which adequately represent the range of ink film thicknesses specified in 5.3. These samples may be prepared on a printability tester by running up a small quantity of ink on the inking system, weighing the printing forme prior to printing and then printing the test sample on the reference substrate. The printing forme is then re-weighed and the difference recorded. If the mass density of the ink is known (which may be determined by weighing a known volume of ink) and the printed area is measured, it is possible to calculate the ink film thickness applied to the paper from the difference in mass before and after printing. The ink film thickness, s, may be calculated using the following equation:

$$s = \frac{\Delta m}{\rho \times A}$$

where

Δm is the difference in mass of the forme before and after printing;

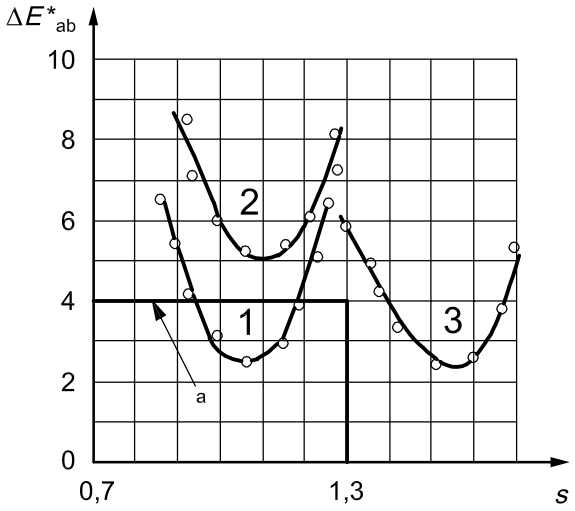
ρ is the mass density of the ink;

A is the area printed.

After the inking unit has been cleaned, a slightly different amount of ink to that used the first time should then be applied to the inking system and the procedure repeated. The process is then repeated time and again, with differing quantities of ink each time, until a number of samples covering the range of ink film thicknesses specified in 5.3 have been prepared.

When dry, a number of the printed samples are selected and their colour is measured as specified in 4.2.4. The colour difference between each sample and the colours specified in 5.1 are then calculated and plotted as a function of ink film thickness as shown in Figure B.1. The ink complies with this part of ISO 2846, if at some ink film thickness within the range specified in 5.3, the colour conforms to the values and tolerances specified in Table 1.

Figure B.1 shows the tolerance range for an ink. Curve 1 shows an ink complying with this part of ISO 2846. Curves 2 and 3 are examples of inks which do not comply with this part of ISO 2846. Curve 2 is an ink of the wrong colour, most probably of incorrect hue, whereas Curve 3 shows an ink of the correct colour but with the wrong pigment concentration.



Key

s ink film thickness, in micrometres

ΔE^*_{ab} colour difference

1 ink which complies with this part of ISO 2846

2 ink which does not comply with this part of ISO 2846 due to a deviation in colour

3 ink which does not conform with this part of ISO 2846; it is correct in colour but not in concentration

a Tolerance range: $\Delta E^*_{ab} = 4,0$; 0,7 µm $\leqslant s \leqslant$ 1,3 µm.

Figure B.1 — Examples of inks for coldset offset lithographic printing tested in accordance with this part of ISO 2846

B.2 Determination of transparency

Using the procedure described in B.1, a series of prints is made covering at least the range of ink film thicknesses specified in 5.3 and preferably beyond for higher precision. For this test a black paper is used. For availability of such a substrate see footnote in clause 4.2.2.

For the determination of transparency each strip of black substrate should be coded and the colour of the black measured on each, in a defined area, prior to overprinting with the test inks over the range of ink film thicknesses specified.

After the samples which have been printed with the test inks are dry, the colour of each sample should be measured as described earlier, in the same place as it was measured for the black.

The colour difference between the two measurements is then calculated for each sample and these are plotted as a function of ink film thickness. The “best fit” straight line through these points is then drawn as shown in Figure B.2 and the slope of the line calculated. (Alternatively, the regression coefficient may be calculated directly from the data.) The reciprocal of this value is then computed and is the transparency measurement value, T. Using the graphical method this value may be calculated directly as follows:

$$T = \frac{s_1 - s_2}{\Delta E^*_{ab,1} - \Delta E^*_{ab,2}}$$

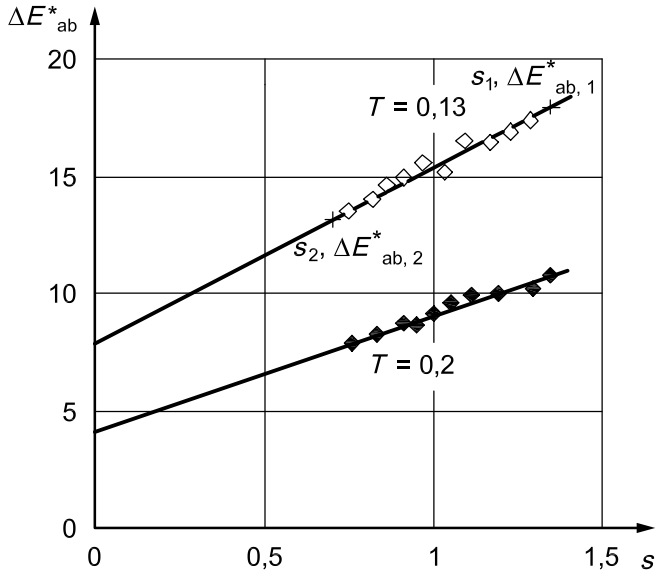
where

s_1 and $\Delta E^*_{ab,1}$ are the ink film thickness and colour difference for a point on the graph at the higher level of film thickness;

s_2 and $\Delta E^*_{ab,2}$ are the ink film thickness and colour difference for a point on the graph at the lower level of film thickness.

These points are shown in Figure B.2.

An ink is in conformance with the transparency requirements of this part of ISO 2846 when the computed value of T is either negative or greater than the value specified in 5.2.



Key

s ink film thickness, in micrometres

ΔE^*_{ab} colour difference

T transparency measurement value

Figure B.2 — Assessment of transparency

Annex C
(informative)

Spectral data

For some applications, such as calculating tristimulus values for a different observer or illuminant, it is useful to have recourse to spectral data. As already stated it was deliberately decided not to standardize such data since it can be very restrictive for ink manufacturing and future development of ink with improved properties. However, the following data may be taken as “typical”. Since most inks are currently based on the same pigments, any differences at the present time are likely to be small. It cannot be presupposed that standard printing inks necessarily comply with the data presented here. These values are derived from measurements made on samples printed on the reference substrate with white backing (see 4.2.4).

Table C.1 presents data for 0°:45° geometry. This data has been used to compute equivalent tristimulus values to those provided in Table 1 and Annex A.

Table C.1 — Typical spectral reflectance data for inks in compliance with this part of ISO 2846, 0°:45° geometry

Wavelength	Reflectance factor				
nm	Cyan	Magenta	Yellow	Black	Substrate [a]
380	0,175	0,159	0,120	0,042	0,279
390	0,192	0,158	0,106	0,044	0,304
400	0,201	0,151	0,091	0,044	0,306
410	0,275	0,183	0,099	0,056	0,412
420	0,335	0,211	0,103	0,070	0,508
430	0,391	0,234	0,106	0,074	0,555
440	0,449	0,250	0,108	0,077	0,584
450	0,495	0,254	0,115	0,080	0,604
460	0,518	0,246	0,126	0,083	0,620
470	0,533	0,230	0,134	0,085	0,634
480	0,536	0,209	0,148	0,087	0,644
490	0,530	0,191	0,192	0,089	0,658
500	0,514	0,173	0,296	0,090	0,668
510	0,486	0,154	0,447	0,091	0,672
520	0,445	0,138	0,546	0,091	0,669
530	0,391	0,131	0,582	0,089	0,662
540	0,333	0,130	0,602	0,090	0,656
550	0,275	0,126	0,611	0,092	0,653
560	0,218	0,123	0,608	0,092	0,649
570	0,179	0,132	0,604	0,093	0,647
580	0,158	0,162	0,606	0,098	0,646
590	0,148	0,246	0,615	0,101	0,648
600	0,141	0,381	0,625	0,101	0,658
610	0,138	0,522	0,646	0,100	0,680
620	0,140	0,624	0,670	0,100	0,705
630	0,144	0,679	0,691	0,102	0,725
640	0,149	0,713	0,710	0,103	0,745
650	0,159	0,738	0,729	0,106	0,764
660	0,172	0,759	0,747	0,109	0,782
670	0,180	0,771	0,760	0,113	0,795
680	0,178	0,777	0,767	0,117	0,806
690	0,173	0,780	0,771	0,119	0,816
700	0,164	0,783	0,777	0,122	0,825
710	0,156	0,783	0,780	0,125	0,831
720	0,149	0,784	0,783	0,128	0,838

[a] Reference substrate, see Annex A.

Bibliography

[1] ISO 12647-3, *Graphic technology — Process control for the production of half-tone colour separations, proofs and production prints — Part 3: Coldset offset lithography on newsprint*

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