INTERNATIONAL STANDARD

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

Part 2: Offset lithographic processes

Technologie graphique — Maîtrise des procédés pour la fabrication des séparations de couleur en ton tramé, des épreuves et des tirages en production —

Partie 2: Procédés lithographiques offset

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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).

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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 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 which has been extensively revised. The revisions include the following:

a) deletion of film-based requirements;

b) changes in proof requirements;

c) changes in printing conditions;

d) changes in the colouration of the primary and secondary solids;

e) introduction of new tone value increase curves;

f) 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*

Introduction

This part of ISO 12647 lists values or sets of values of the primary process parameters specified in ISO 12647-1 and related technical properties of a half-tone offset lithographic print. Primary parameters constitute a general printing condition and are defined here as the substrate description, the colorant description, the screening description, the tone value increase and the ink sequence. Since the printing ink to be used in this International Standard is to conform to ISO 2846-1, it is in general not necessary to name it as a primary process parameter.

Conformance to the specified values in proof and production printing ensures, in principle, a good visual match between specimens produced. A visual and in part measurement-wise "proof-to-print match" is essential for globally consistent printing and publishing workflows in general. A press proof print might be necessary when using specific printing conditions that use different types of surface finishing.

As the printing and publishing world has accepted former editions of this International Standard, it has struggled to implement the different paper types. The paper type specifications by means of tristimulus values, originally defined as a guideline for press proof prints, have been wrongly interpreted as an exclusive prerequisite for papers to be "in conformance with ISO 12647-2". In addition, it has become evident that the paper types defined by this International Standard reflect market papers poorly. Therefore, some industry groups, while using the general principles of this International Standard, have established additional printing conditions with different paper specifications.

When revising this International Standard a new paper categorization was established. This was necessary since there is no agreed upon method to predict the printing behaviour based on colorimetric readings of the unprinted print substrate. When the visual printing characteristics of typical printed papers were analysed, different sets of colorant descriptions were identified. A closer look revealed that these sets corresponded to the surface (CIE whiteness, gloss, and coating) and mass per area characteristics (opacity).

A print is therefore in conformance with this International Standard when:

— the colorimetric aims of the process colours, defined by the general printing conditions and using typical means of inking, are achievable;

— by agreement between all parties, an additional printing condition is established and aim values for this printing condition are clearly communicated, for example by exchanging a characterization.

This International Standard addresses typical industrial printing under feasible economical constraints. The tolerance values have therefore been chosen to provide a reasonable balance between customer expectations (meaning small variations), technical production limits and production costs. Assuming agreements between all parties concerned, tolerances might be tightened especially when primary or secondary process parameters (e.g. paper) can be fixed in the planning stage.

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

Part 2: Offset lithographic processes

1 Scope

This part of ISO 12647 specifies a number of process parameters and their values to be applied when producing colour separations, printing formes and print production for four-colour sheet-fed and web-fed offset printing presses excluding coldset offset lithography on newsprint.

The parameters and values are chosen in view of the typical process covering the process stages "colour separation", "proof production", "making of the printing forme", "OK print" and "production printing" on all kinds of commercially available production substrates.

This part of ISO 12647:

— is directly applicable to press proof prints and printing processes that use colour separation printing formes as input;

— is applicable to press proof prints and printing processes with more than four process colours as long as direct analogies to four-colour printing are maintained, such as for data and screening, for print substrates and printing parameters;

— is applicable to printing on cardboard material for packaging;

— is applicable for all kinds of drying methods such as heat-set, infrared, and ultraviolet;

— provides references for quality assurance and quality management.

This part of ISO 12647 is not applicable to processes other than offset such as printing directly from digital data where there is no intermediate image carrier, or where the image carrier can be refreshed for each impression and thus each impression can be different in content.

2 Normative references

The following referenced 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 2846-1, *Graphic technology — Colour and transparency of printing ink sets for four-colour printing — Part 1: Sheet-fed and heat-set web offset lithographic printing*

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

ISO 8254-2, *Paper and board — Measurement of specular gloss — Part 2: 75 degree gloss with a parallel beam, DIN method* [alternative to ASTM D7163]

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

ISO 11475, *Paper and board — Determination of CIE whiteness, D65/10 degrees (outdoor daylight)*

ISO 12647-1, *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, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ASTM D7163, *Standard Test Method for Specular Gloss of Printed Matter* [alternative to ISO 8254-2]

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
area coverage
ratio of the area covered with ink to the entire area in an ink zone

3.2
calibration
adjustment based on a comparison between a standard and a unit under test

3.3
characterization data
set of tone values and associated colorimetric values that fully describe a given printing process

3.4
tone value
⟨printing forme⟩ percentage of surface area that is covered by printing ink

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.

NOTE Press proof prints are test prints of the data files on a printing press which may serve as a reference for subsequent printing. While most proofs are digital proofs, for colour- or content-critical work there is a need for press proof prints with the same setup as the production print.

4.2 Data files and printing formes

4.2.1 Data delivery

Data delivered for printing shall be in the colour formats CMYK or three-component and should be exchanged using PDF/X [6][7] data formats.

The intended printing condition shall be indicated. 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 [3][4] or an International Colour Consortium (ICC) output profile [5] shall be communicated.

If the data are other than CMYK, the data shall be defined by colorimetric descriptions using an ICC profile or another mechanism and an ICC CMYK output profile shall be included. The rendering intent to be used for each data element shall be communicated.

If the characterization data or ICC output profile provided conflicts 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

prior to print production. The aims for process control should be taken from characterization data, if agreed between all parties. Where this is done, densitometric tone values are not usually available and colorimetric tone values should be used. Further information on the relationship between colorimetric and densitometric tone values can be found in ISO/TS 10128.

NOTE 1 A printing condition is defined here as a print substrate description, a colorant description, a screening description, an ink set and a printing sequence.

NOTE 2 Quality control of the content of a print job prior to final production checks is recommended since PDF/X conformance does not necessarily ensure a suitable image resolution or other production dependent criteria.

NOTE 3 Additional spot colours are allowed but this part of ISO 12647 does not make provisions for tolerances.

4.2.2 Printing forme quality

The resolution of the plate setter should be selected to ensure that at least 150 tone value steps are reproduced.

EXAMPLE If, for a screen employing single half-tone cell modulation, the intended nominal screen ruling is 80 cm^{-1}, the resolution of the plate setter should not be less than 1 000 cm^{-1}. For a screen with super-cell technology, it is possible to set the resolution to a smaller value.

4.2.3 Screen frequency (periodic screens)

For four-colour work, the screen frequency (screen ruling) for periodic screens should be within the range from 48 cm^{-1} to 80 cm^{-1}.

Preferred nominal screen frequencies are:

a) 48 cm^{-1} to 80 cm^{-1} for coated paper; and

b) 48 cm^{-1} to 70 cm^{-1} for uncoated paper.

NOTE 1 Outside of the range 48 cm^{-1} to 80 cm^{-1}, the general principles specified in ISO 12647-1 remain valid but specific values might differ.

NOTE 2 The screen frequency is often varied slightly from one process colour to another in order to minimize moiré patterns. For example, there might be a difference of up to 6 % of the nominal screen frequency between the colours C, M, Y.

NOTE 3 For the black or yellow colour half-tone, a screen frequency is sometimes used which is substantially finer than the nominal screen ruling of the remaining colours, for example, 84 cm^{-1} versus 60 cm^{-1}.

NOTE 4 Screen frequencies are often required or given in lpi (lines per inch). To convert between screens per cm and lines per inch a conversion factor of 2,54 should be used.

EXAMPLE The requirement 4.2.3 given in lpi will read as follows (rounded to commonly used integral numbers): for four-colour work, the screen frequency (screen ruling) for periodic screens should be within the range from 120 lpi to 200 lpi. Preferred nominal screen frequencies are a) 120 lpi to 200 lpi for coated paper; and b) 120 lpi to 175 lpi for uncoated paper.

4.2.4 Dot size (non-periodic screens)

For four-colour work, the screen dot size for non-periodic screens should be within the range 20 µm to 40 µm.

Preferred nominal screen dot sizes are:

a) 20 µm to 30 µm for coated paper; and

b) 30 µm to 40 µm for uncoated paper.

NOTE Outside of the range 20 µm to 40 µm, the general principles specified in ISO 12647-1 remain valid but specific values might differ.

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°.

For half-tone dots with a principal axis, the nominal difference between screen angles for cyan, magenta and black should be 60°, with the screen angle of yellow separated by 15° from another colour. The screen angle of the dominant colour should be 45° or 135°.

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

For periodic screens, circular, square or 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 and the second link-up no higher than at 60 % tone value.

4.2.7 Tone value sum

The tone value sum for coated print substrates should be less than 330 % but shall not exceed 350% for sheet-fed and should be less than but shall not exceed 300% for heat-set web printing. The tone value sum for other print substrates should be less than but shall not exceed 300 % for sheet-fed and 270 % for heat-set web printing.

NOTE Press problems might be encountered at high levels of tone value sum. There might be poor ink trapping, back transfer and set-off due to insufficient ink drying.

4.2.8 Grey reproduction and grey balance

The tone values of cyan, magenta and yellow that lead 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 (L^*_{paper}, a^*_{paper}, b^*_{paper}) and solid CMY inks overprint (L^*_{cmy}) 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 can 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. See Annex A for more details.

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 11 are not exceeded.

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

4.3 Proof or production print

4.3.1 General

A printing condition for sheet-fed and web-fed offset printing shall be communicated by a print substrate description, a colorant description, a screening description, an ink set and a printing sequence.

Standard printing conditions are shown in Table 1. For all printing conditions described in this part of ISO 12647 the ink set shall be according to ISO 2846-1 and the printing sequence shall be Black – Cyan – Magenta – Yellow.

Table 1 — Standard printing conditions for typical print substrates

Printing condition	Print substrate description (Table 2 and 3)	Colorant description (Table 5 and 6)	Screening description			
			Periodic screens		Non-periodic screens	
			TVI curve	Frequency (cm^{-1})	TVI curve	Spot size (µm)
PC1	PS1	CD1	A	60 to 80	E	20(25)
PC2	PS2	CD2	B	48 to 70	E	25
PC3	PS3	CD3	B	48 to 60	E	30
PC4	PS4	CD4	B	48 to 60	E	30
PC5	PS5	CD5	C	52 to 70	E	30(35)
PC6	PS6	CD6	B	48 to 60	E	35
PC7	PS7	CD7	C	48 to 60	E	35
PC8	PS8	CD8	C	48 to 60	E	35

Additional printing conditions based on commonly used print substrates, different printing sequences and different ink sets should follow the scheme described in this and the following clauses; they should be established by defining combinations of print substrates and colorant descriptions (comparable to Tables 2 and 3 and Tables 5 and 6), screening descriptions and TVI curves (comparable to Table 9 and Figure 3).

Standard printing conditions are usually characterized by collecting (smoothing and averaging where appropriate) colour measurement data from one or more printing presses that have been carefully set up to a given printing condition. Such a collection of measurement data along with associated metadata describing the characterized printing condition is known as a characterization data set. When such characterization data are used to describe one of the printing conditions defined by this part of ISO 12647 the print substrate, colorant, screening, ink set and printing sequence for the printing condition from which the characterization data was collected shall be clearly indicated.

NOTE 1 Colorimetric characterization data, as specified in ISO 12642-1 and ISO 12642-2, contain all the data to be specified in accordance with 4.3.2.1, 4.3.2.3, and 4.3.4.1 of this part of ISO 12647.

NOTE 2 A characterization data set, or an ICC profile derived from it, is required when making proofs according to ISO 12647-7. In practice this means that characterization data sets provide a convenient means for the communication of standard printing conditions. Characterization data for standard printing conditions are available from research or trade associations.[1]

NOTE 3 Work separated for periodic screens can be printed using non-periodic screens where there is a moiré problem on press. In some cases moiré might introduce tone contouring artefacts and colour shift deficiencies in primary and secondary half-tones.

NOTE 4 Spot sizes for non-periodic screens in parenthesis are recommended for heat-set web offset printing.

4.3.2 Visual characteristics of image components

4.3.2.1 Print substrate colour

The print substrate used for press proof prints should be identical to that of the production print. If this is not possible, the properties of the print substrate for press proof prints should be a close match to those of the production print in terms of colour, CIE Whiteness, gloss, type of surface (coated, uncoated, super-calandered, etc.) and mass-per-area.

Evaluate the match of the press proof print substrate and the production print substrate using the attributes listed in Table 2 and 3. For digital proofing, the requirements defined in ISO 12647-7 apply.

Typical paper characteristics are defined, for information only, in Tables 2 and 3. In order to determine the closest matching printing condition for a given paper type, compare the paper to be used for printing with

the parameters in these tables and select the closest matching reference print substrate. This procedure ensures an easy match of the associated colorant description and therefore the visual appearance.

Production paper comprising a coloration differing from the aim values pertaining to Tables 2 and 3 may not be described by established data characterizations. In this case, a dedicated substrate description using the attributes shown in Tables 2 and 3, and an associated set of characterization data is recommended.

Table 2 — CIELAB coordinates, mass-per-area, and CIE Whiteness for print substrates (informative)

Characteristic	Paper type and surface											
	PS1			PS2			PS3			PS4		
Type of surface	Premium coated			Improved coated			Standard glossy coated			Standard matte coated		
Mass-per-area [a] g/m²	80 to 250 (115)			51 to 80 (70)			48 to 70 (51)			51 to 65 (54)		
CIE Whiteness [b]	105 to 135			90 to105			60 to 90			75 to 90		
Gloss [c]	10 to 80			25 to 65			60 to 80			7 to 35		
Colour [d]	Coordinates			Coordinates			Coordinates			Coordinates		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
White backing	95	1	−4	93	0	−1	90	0	1	91	0	1
Black backing	93	1	−5	90	0	−2	87	0	0	88	0	−1
Tolerance	±3	±2	±4	±3	±2	±2	±3	±2	±2	±3	±2	±2
Fluorescence [e]	moderate			low			low			low		

[a] Values in brackets pertain to the respective colour coordinates given in this table.

[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 should be made using M1.

[e] Typical delta D65 Brightness UV/UV_{ex} evaluated as per ISO 2470-2, and information as recommended in ISO 15397. [8] 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 (0–4), low (4–8), moderate (8–14), high (14–25).

NOTE 1 In terms of gloss and colour, the paper types listed in Tables 2 and 3 are representative for the range of print substrates used for the processes covered in this part of ISO 12647.

NOTE 2 If the final product is subjected to surface finishing this could severely affect the print substrate colour and gloss.