INTERNATIONAL STANDARD

ISO 12647-2

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Graphic technology — Process control for the manufacture 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 offset lithographiques

Reference number
ISO 12647-2:1996(E)

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.

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.

International Standard ISO 12647-2 was prepared by Technical Committee ISO/TC 130, *Graphic technology.*

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

— *Part 1: Parameters and measurement methods*

— *Part 2: Offset lithographic processes*

Annexes A to D of this International Standard are for information only.

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Introduction

When producing a half-tone colour reproduction it is important that the colour separator, proofer 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 and the proof. Such an agreement enables the correct production of suitable separations (without recourse to "trial-and-error") and subsequent production of off-press or on-press proof prints from these separations. The purpose of a proof print is to simulate the visual characteristics of the finished print product as closely as possible.

In order to visually match a particular print, off-press proofing processes may require values for solid tone coloration and tone value increase which are different from those of the printing process they are meant to simulate. This is caused by differences in phenomena such as gloss, light scatter (within the print substrate or the colourant), metamerism and transparency. Such differences are likely for those off-press proofing processes in which the print substrate, the colourants and the technology for applying them are significantly different from offset press printing. In such cases the user or the supplier should ensure that appropriate corrections are specified.

It is necessary to distinguish between primary and secondary parameters. Whereas primary parameters (as listed in this part of ISO 12647) are defined as having a direct bearing on the visual characteristics of the image, secondary parameters only influence the image indirectly by changing the values of primary parameters. Secondary parameters include

— colour separation film thickness;

— image orientation (wrong-reading or right-reading);

— film polarity (negative or positive);

— roughness of the emulsion surface;

— presence of colour marking or register marks.

It is the purpose of ISO 12647-1 to list and explain the minimum set of primary process parameters required to uniquely define the visual characteristics and related technical properties of a half-tone proof or production print produced from a set of half-tone separation films.

This part of ISO 12647 lists suggested values or sets of values of the primary parameters specified in ISO 12647-1 and related technical properties of a half-tone offset print produced from a set of half-tone colour separation films. Where deemed useful, secondary parameters are also recommended for specification.

Other parts of ISO 12647 will relate to other printing processes such as

— newspaper printing;
— gravure printing;
— screen printing.

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

Part 2:
Offset processes

1 Scope

This part of ISO 12647 specifies a number of process parameters and their values to be applied when preparing colour separations for four-colour offset printing or when producing four-colour prints by one of the following methods: heat-set web, sheet-fed or continuous forms process printing, or proofing for these processes; offset proofing for half-tone gravure. The parameters and values are chosen in view of the complete process covering the process stages "colour separation", "making of the printing forme", "proof production", "production printing" and "surface finishing".

This part of ISO 12647 is

- directly applicable to proofing and printing processes that use colour separation films as input;
- directly applicable to proofing and printing from printing surfaces produced by filmless methods and to gravure printing as long as direct analogies to film production systems are maintained;
- applicable to proofing with more than four process colours as long as direct analogies to four-colour printing are maintained;
- applicable by analogy to line screens and non-periodic screens.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 12647. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 12647 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5-3:1995, *Photography — Density measurements — Part 3: Spectral conditions.*

ISO 8254-1:— [1], *Paper and board — Measurement of specular gloss — Part 1: 75° gloss.*

ISO 12647-1:1996, *Graphic technology — Process control for the manufacture of half-tone colour separations, proof and production prints — Part 1: Parameters and measurement methods.*

1) To be published.

3 Definitions

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

3.1 offset (printing) plate: Plane workpiece whose surface has been coated such that an offset printing forme can be produced thereof.

3.2 positive-acting (offset printing) plate: Offset printing plate for use with positive polarity film.

3.3 negative-acting (offset printing) plate: Offset printing plate for use with negative polarity film.

3.4 four-colour continuous forms printing: Offset process performed on small width web-fed presses for use with personalized mailings.

3.5 commercial/speciality printing: General purpose sheet-fed and non-magazine heat-set web offset printing.

3.6 non-periodic (half-tone) screen: Half-tone screen without a regular screen angle and without a constant screen ruling.

4 Requirements

The following subclauses are arranged according to the order set out in ISO 12647-1; they also depend on it for the definition of the data and measurement conditions.

4.1 Colour separation films

4.1.1 Quality

Unless otherwise specified, the core density shall be at least 2,5 above the transmission density of the clear film (film base plus fog). The transmission density in the centre of a clear half-tone dot shall not be more than 0,1 above the corresponding value of a large clear area. The transmission density of the clear film shall not be higher than 0,15. Both measurements shall be made with a (UV) transmission densitometer whose spectral products conform to ISO type 1 printing density as defined in ISO 5-3.

The fringe width shall not be greater than one-fortieth of the screen width; the half-tone dot shall not be split up into distinct parts. The colour separation film quality shall be evaluated according to ISO 12647-1, annex B.

NOTES

1 The clear film density requirement is based on the understanding

— that the density range of the clear areas of all films that are to be exposed onto an offset plate, for consistent work, should not exceed 0,10;

— that 0,05 represents the lowest commonly found value for ISO type 1 printing density.

In order to minimize the impact of the use of half-tone films with clear film densities above this range, agreements between the supplier of colour separations and the recipient are required. Contacting or duplicating can also be used to bring half-tone films with dissimilar clear film densities into agreement.

2 As a practical guide, a core density of 2,5 above the clear film density will normally be achieved if the density of large solid areas is more than 3,5 above the clear film density.

3 If a user wishes to use a blue filter for transmission density measurements it is necessary to determine, for the particular film type and processing conditions, the correlation between densities obtained with the blue filter and those obtained with an ISO type 1 printing density instrument; for the measurement of core density an ISO type 2 printing instrument may be used.

4.1.2 Screen ruling

For four-colour work, the screen ruling (screen frequency) shall be within the range 45 cm^{-1} to 80 cm^{-1}. Preferred nominal screen rulings are:

45 cm^{-1} to 60 cm^{-1} for web offset periodical printing;

52 cm^{-1} to 60 cm^{-1} for continuous forms process printing;

60 cm^{-1} to 80 cm^{-1} for commercial/speciality printing.

NOTES

4 Outside of the range 45 cm^{-1} to 80 cm^{-1} the general principles specified in ISO 12647-1 remain valid but specific values may differ.

5 With computer-generated screening, the parameters "screen ruling" and "screen angle" may be varied slightly in conjuction, from one process colour to another, in order to minimize moiré patterns.

6 For the black colour half-tone a screen ruling may be used which is substantially finer than the nominal screen ruling of the chromatic colours. For example 80 cm^{-1} for K and 60 cm^{-1} for CMY.

4.1.3 Screen angle

For half-tone dots without a principal axis, the nominal difference between the screen angles for cyan, magenta, and black shall be 30°, with the screen angle of yellow separated at 15° from another colour. The screen angle of the dominant colour should be 45°; this value refers to the film.

For half-tone dots with a principal axis, the nominal difference between screen angles for cyan, magenta, and black shall 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°; these values refer to the film.

The preparation of colour separation films for half-tone gravure printing should avoid screen angles between 75° and 105° with colours other than yellow.

NOTE 7 See note 5 in 4.1.2.

4.1.4 Dot shape and its relationship to tone value

Circular, square or elliptical half-tone dot shapes shall be used. For half-tone dots with a principal axis, the first link-up shall occur no lower than at 40 % tone value and the second link-up no higher than at 60 % tone value.

4.1.5 Image size tolerance

For a set of colour separation films in common environmental equilibrium, the lengths of the diagonals shall not differ by more than 0,02 %.

NOTE 8 This tolerance includes image-setter repeatability and film stability.

4.1.6 Tone value sum

Unless otherwise specified, the tone value sum should be less than but shall not exceed 350 % for sheet-fed and 300 % for web-fed printing.

NOTE 9 At high levels of tone value sum press problems such as poor trapping, back transfer and set-off due to sufficient ink drying may be encountered.

4.1.7 Grey balance

Unless otherwise specified, the grey balance should be given by the following tone value combinations.

	Cyan	Magenta	Yellow
Quarter tone	25 %	19 %	19 %
Mid tone	50 %	40 %	40 %
Three-quarter tone	75 %	64 %	64 %

4.2 Print

4.2.1 Visual characteristics of image components

4.2.1.1 Print substrate colour

The print substrate used for proofing should be identical to that of the production. If this is not possible, the properties of the print substrate should be a close match to that of the production in terms of colour, gloss, type of surface (coated, uncoated, super-calendered, etc.) and mass per area. Press proofing should be carried out on the closest match selected from five typical paper types, whose attributes are listed in table 1. For off-press proofing the print substrate should be selected to conform as closely as possible to the attributes listed in table 1 of the paper type representing the envisaged production paper. The type of paper shall be stated.

Table 1 — CIELAB L^*, a^*, b^* values, gloss, brightness and tolerances for typical paper types

Paper type	L^* [1]	a^* [1]	b^* [1]	Gloss [2]	Brightness [3]	Mass per area [4]
	1	1	1	%	%	g/m²
1: Gloss-coated, wood-free	93	0	–3	65	85	115
2: Matt-coated, wood-free	92	0	–3	38	83	115
3: Gloss-coated, web	87	–1	3	55	70	70
4: Uncoated, white	92	0	–3	6	85	115
5: Uncoated, yellowish	88	0	6	6	85	115
Tolerance:	± 3	± 2	± 2	± 5	—	—
Reference paper [5]	95	0	5	70-80	80	150

1) Measurement according to ISO 12647-1:1996, 5.6: Black backing, D_{50} illuminant, 2° observer, 0/45 or 45/0 geometry.
2) Measurement according to ISO 8254-1.
3) Reflectance at 460 nm, informative only.
4) Informative only.
5) Paper used for ink set test (see ISO 2846-1), informative only.

NOTES

10 In terms of gloss and colour, the paper types listed in table 1 represent the corner stones of the range of print substrates used for the processes covered in this part of ISO 12647, with the following exceptions:

— the paper types 1 and 2 are not typical for web-fed magazine printing except for covers;

— paper types 3 and 5 are not typical for four-colour business forms printing.

11 If the final product is to be surface finished, this may severely affect the print substrate colour. See also note 17 in 4.2.1.2.

12 The L^*, a^*, b^* values for the conditions "D_{65}" or "white backing" agree with those specified in table 1 within the tolerances specified there.

13 The parameters of the reference paper specified in ISO 2846-1 have been included in table 1, for information only, in order to provide a connection to this related International Standard. Note that some values differ from ISO 2846-1 due to the black backing.

14 The mass per area specified for paper type 3 represents a compromise between web production papers with typically 60 g/m² to 65 g/m² and a well-known web proofing paper with 90 g/m². When measured with black backing, the difference between similar papers of 70 g/m² and 90 g/m² corresponds to $\Delta L^* = 0{,}7$.

15 Although less commonly used, some web papers in the mass per area range of type 3 papers have b^* values in the range 0 to –3.

4.2.1.2 Print substrate gloss

The gloss of the print substrate used for proofing should be a close match to that of the production print substrate. If this is not possible, press proofing may be carried out on the closest match selected from the paper types listed in 4.2.1.1.

NOTES

16 The gloss values of the paper types described in 4.2.1.1 are given in table 1.

17 If the final product is to be surface finished this will severely affect the gloss. In critical cases, the result of the colour separation stage may be best judged by means of a proof that closely matches the gloss of the final surface-finished print product. In order to facilitate the matching of the production image to the proof image at the make-ready stage, it is a good plan to provide the production printer with two proof prints: a proof print whose gloss matches that of the (unfinished) production print substrate and a proof print which closely matches the gloss of the final surface-finished print product.

4.2.1.3 Ink set colours

For the five print substrates of 4.2.1.1, the CIELAB colour coordinates L^*, a^*, b^* of the process colour solids on the proof shall agree with the aim values specified in table 2 within the appropriate deviation tolerances specified in table 3. The colour coordinates of the two-colour overprints without black ink should be as given in table 2.

The deviation of the process colour solids of the production print is restricted by the condition that the colour differences between proof and OK print shall not exceed the appropriate deviation tolerances specified in table 3.

The variability of the process colour solids in production is restricted by the following condition. For at least 68 % of the prints, the colour differences from the OK print shall not exceed, and should not exceed one half of, the appropriate variation tolerances specified in table 3.

NOTES

18 The distribution of ΔE^*_{ab} 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 of the mean.

19 Colour coordinates of the ink set colours for illuminant D_{65} are given in table B.1 of the informative annex B. If a white backing is used instead of a black backing, the colour coordinates a^* and b^* of tables 2 and B.1 remain essentially the same. However, the L^* values are between 2 and 3 higher, depending on paper opacity.

20 As a secondary reference, reflection densities for the process colours as measured with four spectral responses are provided in table B.2.

21 If the final print product is to be surface finished, the colours may deviate appreciably from those of the unfinished print. See also note 11 in 4.2.1.1 and note 17 in 4.2.1.2.

Table 2 — CIELAB coordinates of colours for the colour sequence cyan-magenta-yellow (unit: 1)

Paper type [1]:	1	2	3	4	5
	$L^*/a^*/b^*$ [2] [3]	$L^*/a^*/b^*$ [2] [3]	$L^*/a^*/b^*$ [2] [3]	$L^*/a^*/b^*$ [2] [3]	$L^*/a^*/b^*$ [2] [3]
Black	18/ 0/ –1	18/ 1/ 1	20/ 0/ 0	35/ 2/ 1	35/ 1/ 2
Cyan	54/–37/–50	54/–33/–49	54/–37/–42	62/–23/–39	58/–25/–35
Magenta	47/ 75/ –6	47/ 72/ –3	45/ 71/ –2	53/ 56/ –2	53/ 55/ 1
Yellow	88/ –6/ 95	88/ –5/ 90	82/ –6/ 86	86/ –4/ 68	84/ –2/ 70
Red	48/ 65/ 45	47/ 63/ 42	46/ 61/ 42	51/ 53/ 22	50/ 50/ 26
Green	49/–65/ 30	47/–60/ 26	50/–62/ 29	52/–38/ 17	52/–38/ 17
Blue	26/ 22/–45	26/ 24/–43	26/ 20/–41	38/ 12/–28	38/ 14/–28

1) Paper types according to 4.2.1.1.
2) The colours were derived from those of ISO 2846-1 by the method given in annex A.
3) Measurement according to ISO 12647-1:1996, 5.6: Black backing, D_{50} illuminant, 2° observer, 0/45 or 45/0 geometry.

NOTE 22 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 table 2.

Table 3 — CIELAB ΔE^*_{ab} tolerances for the solids of the process colours (unit: 1)

	Black	Cyan	Magenta	Yellow
Deviation tolerance	4	5	8	6
Variation tolerance	2	2,5	4	3

NOTE 23 Tolerances for special (spot) colours and for package printing should be lower than those given in table 3, especially the colour difference attributable to differences of L^*.

4.2.1.4 Ink set gloss

The gloss of solid tone colours may be specified if deemed necessary.

The specular gloss of the print substrate or ink set single print solid areas shall be measured with light incident at 75° (15° from the plane of the print substrate) and measured at 75°. The instrument used shall conform to ISO 8254-1. Report values in percent, quoting "ISO 8254-1" as the method.

4.2.2 Tone value reproduction limits

Half-tone dot patterns within the following tone value limits (on the film) shall transfer onto the print in a consistent and uniform manner:

screen ruling between 40 cm^{-1} and 70 cm^{-1}: 3 % to 97 %;

screen ruling of 80 cm^{-1} or proof printing for the half-tone gravure process: 5 % to 95 %.

No significant image parts shall rely on tone values outside of the above ranges on the colour separation film.

4.2.3 Tolerance for image positioning

The maximum deviation between the image centres of any two printed colours shall not be larger than one half of the smallest screen width of the four colour separation films.

4.2.4 Tone value increase

4.2.4.1 Aim values

The tone value increase for printing and proofing shall be specified for every process colour either by quoting one of the categories A to H listed in table 4 (shown as graphs in figure 1) or by the values themselves. Alternatively, the tone value increase functions may be specified by graphs such as those of figure 1.

In the absence of specified values, the aim values for the 50 % control patch of the control strip shall be as listed in table 5 for the printing categories shown.

NOTES

24 The tone value increase of the black colour is typically 2 % to 3 % higher than those of the chromatic colours. Black is usually printed on the first press unit and at a higher ink film thickness.

25 If conversion of tone value increase data from one screen ruling to another is desired, see annex C. In the diagrams figure C.1 and figure C.2, corresponding values can be indentified for offset press printing and control patches of 40 % or 80 % tone value on the film. Conversions for off-press proofing may require different curve sets.

26 The values given in table 5 refer to measurement in a control strip with a screen ruling of 60 cm^{-1}, with a DIN E response (this is to the wider one of the two responses specified in DIN 16536-2:1995), with polarization, using the method specified in clause 5. For densitometers without polarization and with ISO Status T response, the tone value increase data for cyan, magenta, and black are approximately equal to those shown in table 5; the values for yellow are 2 % smaller.

Table 4 — Tone value increase relative to a control strip (in percent)

	Tone value increase on print							
Film	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
25	9	12	15	18	20	23	26	29
40	13	16	19	22	25	28	31	34
50	15	17	20	23	25	28	31	33
70	14	16	17	18	20	21	23	24
75	13	14	15	16	17	18	19	20
80	12	12	13	14	14	15	16	17

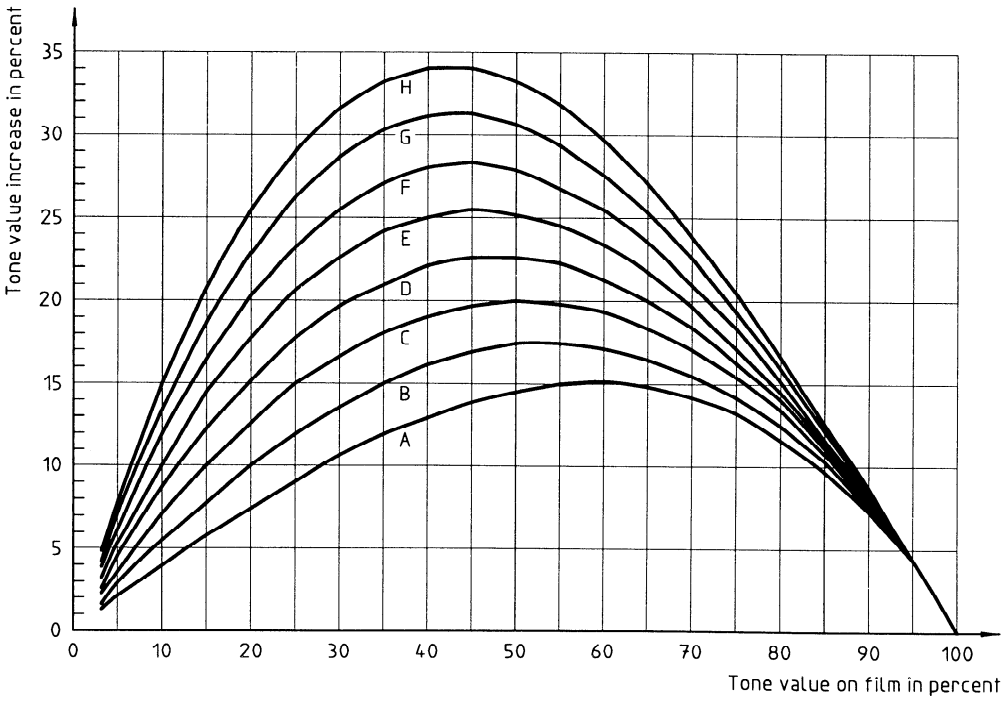

Figure 1 — Tone value increase curves for the categories defined in table 4
(The latter contains rounded numbers whereas the curves depend on original data.)