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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

Technology graphique — Contrôle des processus de confection de sélections couleurs tramées, d'épreuves et de tirages —

Partie 7: Processus d'épreuve travaillant directement à partir de données numériques

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Contents

Page

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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 12647-7:2007), of which it constitutes a minor revision with the following changes:

— clear up the subject matter on certification issues to comply with the ISO requirements;

— update of references.

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

ISO 12647-1 serves to provide definitions, the general principles, the general order, the material to be covered in ISO 12647-2 to ISO 12647-7, the definition of the data, the measurement conditions, and the reporting style.

This part of ISO 12647 relates to the subject of digital proofing and establishes proofing requirements for the most stringent part of the printing and publishing market.

This part of ISO 12647 mainly lists values or sets of values, and their tolerances, of the primary parameters specified in ISO 12647-1, especially for digital proof printing. Primary parameters that define a printing condition include the screening parameters, where applicable, the colours of the solids, the colour of the print substrate, colours intermediate between these and the tone value increase curve. Adherence to these values essentially ensures that a grey, which at the colour separation stage was composed for a particular printing condition, also prints as a grey colour in proofing and printing. Remaining deviations from grey due to differences in trapping can then be removed by adjusting the colouration within the tolerances provided. This part of ISO 12647 further specifies test methods for those properties of digital proof prints and their substrates that are considered relevant for stable and reliable conditions, and thus for a certification procedure.

The graphic technology industry makes extensive use of proofing to predict the rendering of digital data files by a wide variety of high-definition, high-quality off-press printing processes and applications. Each prediction is based on a characterisation data set that defines a particular printing condition.

Typically, the specified printing condition is defined through an International Color Consortium (ICC) profile or the associated characterisation data set, both of which relate source data and colourimetrically defined printed colour. Such data may be derived from printing conditions conforming to the pertinent process standard of the ISO 12647 series by industry trade groups or individuals.

The purpose of a proof print is to simulate the visual characteristics of the finished production print product as closely as possible. In order to visually match a particular printing condition, proofing processes require a set of parameters to be specified that are not necessarily identical to those put forward in ISO 12647-1 or another part of ISO 12647. This is caused by differences in colourant spectra or phenomena such as gloss, light scatter (within the print substrate or the colourant), and transparency. In such cases, it is also found that spectrocolourimetry takes precedence over densitometry.

Another problem area is the matching of a double-sided production print on a lightweight printing substrate, such as often used in heat-set web and publication gravure printing, to a digital proof on a nearly opaque substrate. If the proof was produced using a colour management profile based on measurements with white backing, there will be an unavoidable visual and measurable difference between the proof on the one hand and the production print placed on black on the other hand. A black backing is required for double-sided production printing on non-opaque prints, as specified in the pertinent parts of ISO 12647. The possible occurrence of such differences needs to be well communicated, in advance, to all parties concerned.

Historically, there has been no consistency in the way that either the characterisation data or the criteria and limits for a satisfactory match have been provided. This has led to significant redundancy and inconsistencies in the evaluation of proofing systems for different, but similar, applications, and a cost and time burden on the industry. This International Standard therefore attempts to provide guidance in this area by providing specifications and associated testing procedures.

Annex A gives the requirements for the digital proof prints listed in the main body of this part of ISO 12647; these are weighted with respect to their relevance in two typical situations:

— requirements with which a proof print, made for a particular printing condition, must comply if it is to be referenced in a contract between the printer and the provider of the digital data (“Certified Proofing System”);

— requirements with which a vendor’s proofing system, comprising hardware and software, must comply if it is to be considered capable of reliably producing digital contract proofs for a particular printing condition (“Certified Proofing System”).

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

1 Scope

This part of ISO 12647 specifies requirements for systems that are used to produce hard-copy digital proof prints intended to simulate a printing condition defined by a set of characterisation data. Recommendations are provided with regard to appropriate test methods associated with these requirements.

This part of ISO 12647 is independent of the method used to produce a digital proof print.

2 Normative references

The following 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 3664, *Graphic technology and photography — Viewing conditions*

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

ISO 12040, *Graphic technology — Prints and printing inks — Assessment of light fastness using filtered xenon arc light*

ISO 12639, *Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)*

ISO 12640-1, *Graphic technology — Prepress digital data exchange — Part 1: CMYK standard colour image data (CMYK/SCID)*

ISO 12642-2, *Graphic technology — Input data for characterization of 4-colour process printing — Part 2: Expanded data set*

ISO 12647-1:2004, *Graphic technology — Process control for the production of half-tone colour separations, proof and production prints — Part 1: Parameters and measurement methods*

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

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
digital proof
soft proof or hard-copy proof produced directly from digital data, on a display or a substrate

3.2
digital proof print
digital hard-copy proof
digital proof produced as a reflection copy on a proofing substrate

3.3
proofing substrate
printing substrate used for hard-copy proofing processes

3.4
half-tone proof print
proof print made using the same screening technology (generally centre-weighted half-tone dots) as the intended production printing

Note 1 to entry: This is done to attempt to produce (and therefore check for the existence of) the same screening artefacts, such as rosettes, moiré, or aliasing patterns, as expected in the corresponding production print. One possibility is to base proofing on the bitmap produced on the production plate or film setter.

3.5
print stabilisation period
time elapsed since the production of a proof print until a stable colour is achieved

Note 1 to entry: This property is to be specified by the manufacturer.

4 Requirements

4.1 Data files, simulation of screens

4.1.1 Data delivery

Digital proofing systems should accept digital data delivered as PDF/X data files as defined in ISO 15930 (all parts) or TIFF/IT files as defined in ISO 12639. Where TIFF/IT files are used, colour information shall be included using tag 34675 or tag 34029 as defined in ISO 12639.

NOTE PDF/X requires that the intended printing condition be indicated. Where the intended printing condition is included in the registry of characterisations maintained by the International Color Consortium (ICC) and the digital data are cyan-magenta-yellow-key (black) (CMYK), the name used in the ICC registry is usually used for identification in lieu of including an ICC output profile. If the intended printing condition is not included in said registry, PDF/X requires that an ICC output profile be included. If the data are other than CMYK, the data are required to be defined colourimetrically using an ICC input profile or another mechanism and an ICC CMYK output profile is required to be included; the rendering intent to be used with the output profile is required to be communicated.

4.1.2 Screen frequency

Half-tone proofs should have the same nominal screen frequencies (screen rulings) as the production press print to be simulated.

4.1.3 Screen angle

Half-tone proofs should have the same screen angles as the production print to be simulated.

4.1.4 Dot shape and its relationship to tone value

Half-tone proofs should have the same general dot shape as the production print to be simulated.

4.2 Proof print

4.2.1 Proofing substrate colour and gloss

The digital proofing substrate should, if possible, be the same as the substrate to be used for production printing. Where this is not possible, the digital proofing substrate should have the same gloss and CIELAB a^* and b^* values as the intended production printing substrate within the tolerances listed in Table 1. Where the characteristics of the printing substrate to be used for production printing are not exactly known, a suitable proofing substrate conforming to one of the three types given in Table 1 shall be used.

The proof and production printing substrates should ideally have similar UV responses under the recommended measurement conditions.

Annex A gives requirements for a digital proof print that are weighted with respect to their relevance.

Where the production printing substrate is not identical to the proofing substrate, the colour of the latter shall not vary by more than a CIELAB 1976 colour difference of 1,5 when successively subjected to the following storage conditions in the dark:

a) 24 h at 25 °C and a relative humidity of 25 %;

b) 24 h at 40 °C and a relative humidity of 80 %;

c) one week at 40 °C and a relative humidity of 10 %.

For the same proofing substrate, the variability of colour under light exposure is limited by the condition that the light fastness, as determined in accordance with ISO 12040, shall not be less than 3.

NOTE 1 A light fastness step of 3 corresponds approximately to a 300 d exposure to normal office lighting.

NOTE 2 In production printing, if the final print product is subjected to surface finishing, this might significantly affect the gloss and often also the colour. In critical cases, the result of the colour separation stage is best judged by means of a proof that closely matches the gloss of the final surface-finished print product. For processes with off-press finishing, in order to facilitate the matching of the production image to the proof image at the make-ready stage, it is useful to provide the press operator with two proof prints:

— a proof print whose gloss matches that of the (unfinished) production print substrate;

— a proof print which closely matches the gloss of the final surface-finished print product.

NOTE 3 If the substrate fails this test, it is in all likelihood not environmentally stable and thus not eligible for certification.

Table 1 — CIELAB coordinates, gloss, and tolerances for unprinted proofing substrate types

Proofing substrate type	L^* [a]	a^* [a]	b^* [a]	Gloss [b] %
Glossy white	≥ 95	0 ± 2	0 ± 2	61 ± 15
Semi-matte white	≥ 95	0 ± 2	0 ± 2	35 ± 10
Matte white	≥ 95	0 ± 2	0 ± 2	< 25

NOTE The data specified in this table pertain to unprinted proofing substrates, not to be confused with data pertaining to unprinted production substrate which are given in other parts of ISO 12647.

[a] Measurement in accordance with 5.3.

[b] Measurement in accordance with 5.5.

4.2.2 Colouration of printed parts

The measurement conditions shall be as specified in 5.3; the digital control strip specified in 5.1 shall be used.

The CIELAB colour coordinates of the process colour solids shall agree with the pertinent aim values of the printing condition to be simulated as given by the data (see 4.1.1), within a CIELAB difference of 5; the contribution of the CIE hue difference to the total CIELAB difference shall not exceed 2,5.

The variability of the colouration across the proof print format is limited by the provision that the colours of nine measurement locations evenly spaced on the test object (see 5.2.4), which has been printed without prior modification in view of the printing condition, shall have

— a standard deviation of less than 0,5 each for values of L^*, a^*, and b^*;

— a maximum CIELAB colour difference of 2 between the average value and any one point.

The print stabilisation period shall be specified by the manufacturer. The variability ("fading") of the primary and secondary colour solids over time, in the dark, shall be limited by the condition that the CIELAB colour difference that occurs in the first 24 h after the print stabilisation period has elapsed shall not exceed 1,5.

The light fastness, as determined according to ISO 12040, of the primary colour solids shall not be less than 3.

The CIELAB colour coordinates of the control patches, defined in 5.1 or ISO 12642-2, shall agree with the pertinent aim values of the printing condition to be simulated as given by the data (see 4.1.1) within the tolerances specified in Table 2.

If the proofing conditions are such that the simulation of the production printing substrate patch (C = M = Y = K = 0, i.e. all the components are equal to zero) does require overprinting of the proofing substrate, the CIELAB deviation tolerance for that patch shall be 3, irrespective of what the pertinent part of ISO 12647 stipulates for this tolerance.

4.2.3 Repeatability of proof printing

The variability of the proof print primary and secondary colour solids and primary colour midtone patches from one day to the following shall not exceed a CIELAB colour difference ΔE of 1,5 when the patches are being measured at the same position on the sheet, and after the vendor-specified warming-up period and, if necessary, recalibration.

NOTE For certain proofing systems, the same point on a proof print may be formed from a different source on different days; strictly speaking, this is testing variability not repeatability. For these systems, there is no true test of repeatability.

4.2.4 Colourant rub resistance

Using the test apparatus and method specified in Annex B, the time required by printed solids to reach mechanical stability against a rubbing action should not exceed 30 min or the print stabilisation period, whichever is longer. This test shall be performed for each combination of materials and operating conditions for which the proofing system is to be certified.

NOTE A period of 30 min was chosen because this is believed to represent the expectation of the average user. Where the colour (as distinct from the rub resistance of the colourant) takes longer to stabilise, this requirement can be relaxed.

Table 2 — Additional tolerances for control patches

Control patch description	Tolerance
Simulated print substrate colour of the production printing condition[a]	$\Delta E^*_{ab} \leq 3$
All patches specified in 5.1	Maximum $\Delta E^*_{ab} \leq 6$ Average $\Delta E^*_{ab} \leq 3$
Second half-tone scale composed of the primaries C, M, Y, roughly replicating the colours of the first scale for an average printing condition ("grey balance") (same number of patches as for colours of the first scale)	Average $\Delta H \leq 1{,}5$
Outer gamut patches	Average $\Delta E^*_{ab} \leq 4$
All patches of ISO 12642-2	Average $\Delta E^*_{ab} \leq 4$ 95 % percentile $\Delta E^*_{ab} \leq 6$

NOTE 1 The tolerances pertain to the deviation of the proof values from the values of the characterization data of the printing condition to be simulated.

NOTE 2 The specification of ΔE^*_{ab} tolerances lower than 3 is presently not practical due to poor inter-instrument agreement.

NOTE 3 If the final proof print is subjected to surface finishing, the final colours might deviate significantly from those of the unfinished print. See also Note 2 in 4.2.1. In this case, a new proofer or simulation profile or other adjustments are required.

[a] Required only where the proofing substrate is not identical with the production printing substrate.

4.2.5 Ink set gloss

The gloss of solid tone colours should be visually similar to that of the production print to be simulated. The ink set gloss may be specified if deemed necessary; see 5.5 for the method.

NOTE If the gloss of the proof print is substantially changed by the applied colourants, a surface-finishing step might improve the situation. See 4.2.2.

4.2.6 Tone value reproduction limits

Tints intermediate between the (simulated) substrate white and solid shall transfer onto the proof in a consistent and uniform manner over a tone value range that includes at least the tone reproduction limits of the printing condition to be simulated; see the pertinent part of ISO 12647 for this information.

NOTE It is good prepress practice that no image parts need to rely on tone values outside of the tone value reproduction limits of the production printing process.

4.2.7 Tone value

In addition to the requirements of 4.2.2, the single-colour CMYK patches shall not deviate in tone value (measured colourimetrically) from those of the aim characterisation data by more than 5 % in tone value. For the calculation of tone values from measured and characterisation CIE data, use the method described in 5.4.

4.2.8 Reproduction of vignettes

The test objects specified in 5.2.2 shall show no easily visible steps within the tone value reproduction limits (see 4.2.6), if viewed under ISO viewing condition P1 in accordance with ISO 3664.

4.2.9 Image register and resolving power

The maximum deviation between the image centres of any two printed colours shall not be larger than 0,05 mm. The resolving power of the proof print shall be such that C, M, K positive, non-serif, type of 2-point size, reverse (negative) of 8-point size, and 2-point reverse line are legibly reproduced; the test object specified in 5.2.3 shall be used. The above requirements shall not apply to rough or mechanically unstable substrates such as newsprint and to cases where the tolerances for production printing are substantially greater than 0,05 mm.

NOTE 1 This condition usually corresponds to an output addressability of at least 100 pixels per centimetre.

NOTE 2 This condition includes the effects of colourant migration, if at all present.

4.2.10 Margin information

Every digital proof shall bear a human-readable commentary line printed on a margin where the proofing system designation, the colourant and substrate material types, the printing condition to be simulated, the colour management profile(s) used, and the time and date are given.

NOTE 1 For ink-jet printers, it is useful to print a nozzle test line next to the commentary line so that it is possible to ascertain in retrospect that all nozzles were working.

NOTE 2 In some cases of recalibration, it is useful to reprofile the proofer.

4.2.11 Gamut

For each printing condition to be simulated, the 226 outer gamut patches of ISO 12642-2 shall be proof printed. The average CIELAB 1976 colour difference between actual and aim values for those patches shall not exceed 4; see also Table 2. See Annex C for the list of outer gamut patches of ISO 12642-2.

5 Test methods

5.1 Control strip

On every proof, print a CMYK digital control strip at the output intent of the printing condition to be simulated. The control elements identified in the list below should be included while keeping the total number of patches within reasonable limits. To provide compatibility with characterisation data, as many control patches as possible should be selected from ink value combinations of ISO 12642-2. Select the control patches such that the following control patch types are covered:

a) solid tones of the chromatic primaries and their secondaries C,M,Y,R,G, and B (6 patches);

b) mid- and shadow tones of the chromatic primaries and their secondaries C,M,Y,R,G, and B (12 patches);

c) black (K) only half-tone scale with a minimum of six steps that includes the solid;

d) CMY overprint half-tone scale having the same number of steps as the scale in c) that approximately replicates, for an average printing condition, the CIELAB values of the black only scale defined in c);

e) selection of critical tertiary colours such as flesh tones, brown, aubergine, violet (e.g. 15 patches);

f) simulated print substrate colour of the production printing condition (1 patch).

NOTE 1 There are two practical definitions for grey which are sometimes contradictory:

— “A colour having the same a* and b* CIELAB values as the print substrate”;

— “A colour having the same a* and b* CIELAB values as a half-tone tint of similar L* value printed with black ink”.

The latter definition is believed to be useful in the midtone and upwards whereas the former is believed to work best with highlight tones.

