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Graphic technology — Process control for the production of halftone colour separations, proof and production prints —

Part 7: Proofing processes working directly from digital data

Technologie 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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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 12647-7:2013), which has been technically revised with the following changes:

— a number of anomalies identified by industry experts have been addressed;

— substrate selection and measurement specification has been modified to reflect industry practice;

— approximately equivalent CIEDE2000 colour difference values have been added;

— basic support for spot inks has been added;

— wording has been updated to reflect current terminology and industry thinking.

A list of all parts in the ISO 12647 series can be found on the ISO website.

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 12647-8, the definition of the data, the measurement conditions, and the reporting style.

This document relates to the subject of digital proofing and establishes proofing requirements for the most demanding part of the printing and publishing market.

This document specifies aim values (or sets of aim values) and tolerances for the primary parameters specified in ISO 12647-1 for digital proof printing. Primary parameters that define a printing condition include screening parameters (where applicable), the colours of the solids, the colour of the print substrate, colours of intermediate tint values and the tone curve. This document also specifies test methods for those properties of digital proof prints and their substrates that are considered relevant for stable and reliable proofing 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 characterization 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 characterization data set, both of which relate source data and colorimetric values of the 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 spectrocolorimetry 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 characterization 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 document therefore attempts to provide guidance in this area by providing specifications and associated testing procedures.

Annex A summarizes the requirements for the digital proof prints listed in the main body of this document; these are weighted with respect to their relevance in three 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 Proof Creation);

— 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);

— requirements with which a proof print made for a particular printing condition must comply when tested in the field using only a control wedge (Certified Field Proof).

ISO 12647-8 defines requirements for validation prints. Because data are exchanged electronically and visualizations of those data are produced at multiple sites, there is a market need for defined requirements for validation prints to promote a degree of consistency throughout the workflow. Validation prints are intended to be used at early stages of the print production workflow, particularly at the document design stage and have less stringent requirements, particularly on colour fidelity, to allow their production on less elaborate and less costly devices than are required for contract proofs.

Validation prints are not intended to replace “contract proofs” as specified in this document for predicting colour on production printing devices. It is expected that the modifications of the requirements for both contract proofs and validation prints, along with the requirements for contract proofs, will continue in the future as industry requirements and imaging technologies develop.

Graphic technology — Process control for the production of halftone colour separations, proof and production prints —

Part 7:
Proofing processes working directly from digital data

1 Scope

This document 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 characterization data. Recommendations are provided with regard to appropriate test methods associated with these requirements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

ISO 3664, *Graphic technology and photography — Viewing conditions*

ISO 8254-1, *Paper and board — Measurement of specular gloss — Part 1: 75° 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 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 15397:2014, *Graphic technology — Communication of graphic paper properties*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
chromatic primaries
cyan, magenta and yellow process inks

3.2
CIELAB chromaticness difference
ΔC_h
difference between two colours of approximately the same lightness projected onto a constant lightness plane in the CIELAB colour space

Note 1 to entry: This is calculated as $\Delta C_h = \sqrt{(\mathrm{CIE}a_1 - \mathrm{CIE}a_2)^2 + (\mathrm{CIE}b_1 - \mathrm{CIE}b_2)^2}$.

3.3
digital proof
soft-copy proof or hard-copy proof produced directly from digital data, on a display or a substrate, respectively

3.4
digital proof print
digital hard-copy proof
digital proof (3.3) produced as a reflection copy on a *proofing substrate* (3.5)

3.5
proofing substrate
printing substrate used for hard-copy proofing processes

3.6
halftone proof
proof print made using the same screening technology (generally centre-weighted halftone 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.

3.7
primaries
set of process inks: cyan, magenta, yellow and black

3.8
print stabilization 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.

3.9
spot colour inks
inks which are not part of the set of process inks

Note 1 to entry: Spot colour inks are often used when printing brand colours.

4 Requirements

4.1 Colour difference measurements

In previous revisions of this document, CIELAB 1976 colour difference measurements (ΔE^*_{ab}) were used as detailed in ISO 13655 for normative colour difference measurements.

Conformance with this document requires the reporting of all colour differences as CIEDE2000 (ΔE_{00}).

NOTE The relationship of ΔE^*_{ab} to ΔE_{00} varies throughout the colour space and there is no simple correlation between the two metrics. Users are advised that some proofs that are in conformance with ISO 12647-7:2013 may not be in conformance with this document and that some proofs that are in conformance with this document may not be in conformance with ISO 12647-7:2013.

4.2 Data files, simulation of screens

4.2.1 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.

PDF/X requires that the intended printing condition be indicated. Where the intended printing condition is included in the registry of characterizations maintained by the International Color Consortium (ICC) and the digital data are cyan-magenta-yellow-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 colorimetrically 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.

4.2.2 Screen frequency

Halftone proofs should have the same screen frequencies (screen rulings) as the production press print to be simulated within a tolerance of ±3/cm.

4.2.3 Screen angle

Halftone proofs should have the same screen angles (with a tolerance of ±3°) as the production print to be simulated.

4.2.4 Dot shape

Halftone proofs should have the same general dot shape as the production print to be simulated.

4.2.5 Halftone proofs screening

Where halftone proofs are used and the screen frequency, screen angle or dot shape are different from that of the production press to be simulated, these differences shall be reported.

4.3 Proof print

4.3.1 General

When evaluating and communicating proofing substrate properties, the list of required criteria for communication described in ISO 15397 should be followed.

4.3.2 Proofing substrate colour and gloss

In an ideal situation, the digital proofing substrate should be the same as the substrate to be used for production printing. As this ideal situation is seldom possible, the digital proofing substrate shall fulfil all of the following criteria.

a) The gloss level of both the printing substrate and proofing substrates shall be estimated as one of matte, semi-matte or glossy either by the substrate manufacturer or by measuring as described in 5.5. Matte proofing substrates shall not be used to make proofs for glossy printing substrates and glossy proofing substrates shall not be used to make proofs for matte printing substrates.

b) The white point of the unprinted proofing substrate shall allow a colorimetric match of the substrate of the intended printing condition to be simulated with a colour difference of less than or equal to 3,0 ΔE_{00} units when measured according to ISO 13655.

To assure a white point match, the proofing substrate should have a CIEL* value that is higher than the substrate of the printing condition to be simulated.

c) The proofing substrate should belong to the same fluorescence classification as the production paper. Fluorescence classification in four levels of faint, low, moderate, and high shall be made using the testing procedures described in ISO 15397:2014, 5.12.

NOTE Fluorescence as defined in ISO 15397 is calculated by measuring D65 brightness evaluated as per ISO 2470-2 with UV included (UV) and UV excluded (UV_{ex}) and taking the ratio UV/UV_{ex} (see ISO 15397 for details). Usual categories for fluorescence are faint, low, moderate and high. In practice, it is often useful to add an OBA free category in which case the faint category is split into OBA free and faint. The categories and ranges for each are shown in Table 1.

Table 1 — Fluorescence categories and ranges

Category name	Range
OBA free	0 ≤ OBA free ≤ 1
Faint	1 < faint ≤ 4
Low	4 < low ≤ 8
Moderate	8 < moderate ≤ 14
High	14 < high ≤ 25

4.3.3 Colouration of printed parts

The measurement conditions shall be as specified in 5.4; the digital control strip specified in 5.2 and an ISO 12642-2 compliant chart 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 4.2.1), within 3,0 ΔE_{00} units. The CIELAB metric hue difference for CMY 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 objects (see 5.3.4), which have been printed without prior modification in view of the printing condition, shall have the following:

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

— a maximum of 2,0 ΔE_{00} units between the average value and any one point.

The CIELAB colour coordinates of the control patches, defined in 5.2 or ISO 12642-2, shall agree with the pertinent aim values of the printing condition to be simulated as given by the data (see 4.2.1) within the tolerances specified in Table 2.

If the proofing conditions are such that the simulation of the production printing substrate requires overprinting of the proofing substrate, the maximum colour difference between the overprinted proofing substrate and the production printing substrate shall be less than or equal to 3,0 ΔE_{00} units.

Table 2 — Additional tolerances for control patches

Control patch description	Tolerance
All patches specified in 5.2 except spot colour ink patches	Maximum $\Delta E_{00} \leq 5{,}0$ Average $\Delta E_{00} \leq 2{,}5$
A CMY overprint scale roughly replicating the neutral scale for an average printing condition comprising a minimum of five patches spaced approximately uniform intervals across the tone scale	Maximum $\Delta C_h \leq 3{,}5$ Average $\Delta C_h \leq 2{,}0$
All patches of ISO 12642-2	Average $\Delta E_{00} \leq 2{,}5$ 95th percentile $\Delta E_{00} \leq 5{,}0$
All spot colour ink solid patches specified in 5.2	Maximum $\Delta E_{00} \leq 2{,}5$

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.

The specification of ΔE_{00} tolerances lower than 2,5 is presently not practical due to poor inter-model agreement; however, when the same instrument is being used to make both sets of measurements, it is recommended that the tolerances be halved.

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

Spot colour ink solid patches should be clearly identified by the CIELAB colour of the solid spot ink on the print substrate.

There is no standard way to communicate the intended colour of a tint of a spot ink and so communication of spot ink tint aim values and tolerances shall be determined by a separate agreement between participants, for example by means of a physical reference sample.

NOTE 2 Previous versions of this document used the metric ΔH which is very unstable for differences close to the neutral axis and so this has been replaced by chromaticness difference ΔC_h which provides a more reliable measure.

4.3.4 Gamut

The 226 outer gamut patches of ISO 12642-2 shall be proof printed. The average colour difference between actual and aim values for those patches shall not exceed 2,5 ΔE_{00} units. See Annex C for the list of outer gamut patches of ISO 12642-2.

Where multiple printing conditions are supported by a proof printer, this test may be applied to ensure that the proof printer colour gamut is sufficiently large to allow all printing conditions to be supported effectively.

Solid and a representative set of tints, including at least a 50 % tint where a definition is available, of all spot colours to be simulated shall be proof printed. The maximum colour difference between actual and aim values for those patches shall not exceed 2,5 ΔE_{00} units.

NOTE ISO 17972-4 defines an exchange format (CxF/X-4) for spectral measurement data of inks to provide a means to characterize spot colour inks to allow reliable printing and proofing of products that have been designed using these inks.

Spot colours which cannot be simulated by the proofing system, such as when they are out of gamut or where special inks are used, shall be identified and proofs should be accompanied by a physical sample of the required colour.

4.3.5 Permanence of proofing substrate and printed parts

Four copies of a test form shall be prepared on the proofing substrate which contains unprinted parts and patches of printed primaries and secondaries both as solids and as midtones. Combinations of all of the process colours used by the proofing system shall be included in this set which may include more than four colourants.

The four copies of the test form shall be stored for a print stabilization period of at least 24 h in the dark under standard atmosphere according to ISO 187 (at 23 °C ± 1 °C and a relative humidity of 50 % ± 2 % RH).

The CIELAB colour values of the proofing substrate and the printed patches shall be measured according to ISO 13655 M1.

Each of the four copies of the test form shall be subjected to one of the following storage conditions:

a) 24 h at 25 °C ± 1 °C and at a relative humidity of 25 % ± 2 % in the dark;

b) 24 h at 40 °C ± 1 °C and a relative humidity of 80 % ± 2 % in the dark;

c) 1 week at 40 °C ± 1 °C and at a relative humidity of 10 % ± 2 % in the dark;

d) light fastness exposure using a window glass filtered xenon lamp with a level of exposure of the test form corresponding to a light fastness rating of 3 using the blue wool test as described in ISO 12040. Fading of blue wool reference 3 (Acid blue 83) should be used to check the dose.

For each of these treatments, for the substrate and for all patches of the test form, the maximum colour difference between colour values of the patches before and after the treatment shall not exceed 2,5 ΔE_{00} units and should not exceed 2,0 ΔE_{00} units. For matte substrates (see 4.3.2 and 5.5), these tolerances shall be relaxed to 4,0 ΔE_{00}.

Prints with rough surfaces are generally more susceptible to fading but in some cases having a proof with a surface that is similar to that of the production print is more important than having a light fast proof and so these tolerances shall be reduced to allow the use of proofs with mechanically rough surfaces.

The reader should be aware that production printing substrates and inks are usually less stable than typical inkjet-based proofing substrates and inks, see Reference [12]. It is therefore recommended to apply this permanence test to proofs on production printing substrates if the lifetime of such proofs is of any concern.

NOTE It is anticipated that window glass application as described in ISO 105-B02, e.g. optical filters, be fitted to minimize short-wavelength light (less than 310 nm).

4.3.6 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 colour difference of 2,0 ΔE_{00} units. Patches should be measured by the same instrument and at the same position on the sheet after the vendor-specified warming-up period and, if necessary, recalibration.

4.3.7 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 stabilization period, whichever is longer. This test shall be performed for each combination of materials and operating conditions that the proofing system supports.

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 stabilize, this requirement can be relaxed.

