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Graphic technology — Colour conformity of printing workflows

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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 (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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The printing industry comprises a variety of workflows that produce a variety of printed products. For tone and colour reproduction, many ISO standards specify aims and tolerances and they are necessary for the implementation of a colour-managed and standardized workflow.

Even though relevant standards can specify aims and tolerances, the printer's ability to demonstrate conformity of their entire production workflow to these standards often becomes a technical issue as well as a business issue.

Printed colour reproduction quality depends on printing workflow operation. Printing workflow operation is made up of colour definition (what colour to specify), process colour reproduction requirements (what to control) and colour conformity (verify the outcome of the process).

There is a need to provide printers, suppliers, customers and independent bodies with guidelines that will allow them to implement and/or assess a printing workflow in order to achieve and demonstrate conformity of printed products.

This document recognizes and makes provisions for the following:

a) conditions and test methods for file generation conformity;

b) conditions and test methods for file colour separation conformity;

c) conditions and test methods for spot colour and/or composite colour conformity;

d) conditions and test methods for soft proofing conformity;

e) conditions and test methods for hard proofing conformity;

f) conditions and test methods for viewing conditions conformity;

g) conditions and test methods for the evaluation of process, print and colour conformity with respect to specified reference printing conditions (RPCs).

This document is applicable to all printing applications including CMYK, CMYK + spot, spot only, non-CMYK-based processes and multicolour printing.

This document defines the three main production stages of a printed product as follows:

1) colour definition: the first stage where the customer and design services choose the desired brand and visual colours;

2) colour reproduction: the production process which starts upon reception of the job file and ends when the job is printed;

3) colour conformity: the stage which is necessary for the evaluation of the conformity of a printed job.

This document provides:

— a reference framework description for a typical standardized printing workflow (CMYK, CMYK with spot, non CMYK, spot only and multicolour);

— required International Standards applicable at each stage of a standardized printing workflow;

— a description of expected setup, calibration and process control operations required at each stage of printing workflow according to the appropriate International Standards;

— a definition of test conditions for colour conformity activities when these are not clearly mentioned in the relevant standard.

Graphic technology — Colour conformity of printing workflows

1 Scope

This document defines the requirements of printing workflows and evaluation methods for their tone and colour reproduction.

It applies to any printing process using any colourant, such as CMYK, CMYK with spot, non-CMYK, spot only or multicolour.

This document refers and points to international or national standards and can be used to define, evaluate and audit any printing workflow in whole or in part.

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 3664, *Graphic technology and photography — Viewing conditions*

ISO 12646, *Graphic technology — Displays for colour proofing — Characteristics*

ISO 12647 (all parts), *Graphic technology — Process control for the production of halftone colour separations, proof and production prints*

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

ISO 14861, *Graphic technology — Requirements for colour soft proofing systems*

ISO 15930 (all parts), *Graphic technology — Prepress digital data exchange using PDF*

ISO 17972-4, *Graphic technology — Colour data exchange format (CxF/X) — Part 4: Spot colour characterisation data (CxF/X-4)*

CIE 15, *Colourimetry – Third edition*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
actual printing condition
APC
printing condition of the actual printing device or printing process

3.2
colourant
physical substance such as ink or toner which is used alone or as part of a set of colourants in order to produce a colour

3.3
comp
mock-up
proof formed to the shape of the final product indicating whether or not it is colour accurate

3.4
device colour build
colour destined to be printed using a process colourant combination

Note 1 to entry: It is typically used to define device-specific values that allow reproduction of a colour using only process colourants.

3.5
preflight check
file inspection to determine that the digital data contained therein will process such that all data can be accurately imaged to an image carrier or substrate

3.6
print buyer
person or organization that prepares job data and files in order to deliver them to a print service provider

3.7
print service provider
person or company that receives job data and files for the purpose of printing them

3.8
printing condition
set of primary process parameters which describe the conditions associated with a specific printed output and define spectrally or colourimetrically aim values

Note 1 to entry: Such parameters include printing process, substrate, colourant, colourant sequence and screening. Aim values typically comprise colourants and tone reproduction curves description.

Note 2 to entry: For the purposes of colour management, a printing condition should be fully characterized by giving the relationship between process input values (as stipulated in ISO 12642-2 for CMYK) and the corresponding measured colourimetric values.

3.9
process colour
colour that is the outcome of a colour separation operation and that typically requires one or more printing units and process colourants to be reproduced

3.10
process colourant
colourant that is used to print process colours

3.11
reference printing condition
RPC
aim printing condition for the job

3.12
metameric index
difference between spectral radiance distributions within the visible spectrum for two specimens with identical tristimulus values for a given reference illuminant and reference observer

Note 1 to entry: The procedures concerned with a special metamerism index for a change from a reference illuminant to a test illuminant of different spectral composition, or that for a change from a reference observer to a test observer of different colour-matching functions, are called the determination of special metamerism indices.

Note 2 to entry: Requirements for metameric index are specified in CIE 15.

Note 3 to entry: A measure of metamerism for the two specimens is the colour difference between the two metameric specimens caused by substituting an illuminant, "special metamerism index: change in illuminant", and caused by substituting an observer, "special metamerism index: change in observer". The colour difference is evaluated using a CIE colour difference formula and it shall be clearly stated which formula has been used.

Note 4 to entry: It is recommended that for two specimens whose corresponding tristimulus values (X1 = X2, Y1 = Y2, Z1 = Z2) are identical with respect to a reference illuminant and observer, the metamerism index, M, be set equal to the colour difference ΔE*ab between the two specimens computed for the test illuminant or for the test observer.

$$MI = \sqrt{\left(\Delta L^*_1 - \Delta L^*_2\right)^2 + \left(\Delta a^*_1 - \Delta a^*_2\right)^2 + \left(\Delta b^*_1 - \Delta b^*_2\right)^2}$$

3.13
spot colour

colour typically used for the definition of brand colours or special design effects that is usually chosen with the intent of being printed using one printing unit and one spot colourant and that is usually not blended with other colourants

3.14
spot colourant
colourant that is primarily used to print a spot colour even if it can replace or be blended with process colourants to obtain a specific colour gamut or colour reproduction

3.15
substrate-corrected colourimetric aim
SCCA
colour data that are corrected in order to compensate for the colourimetric difference between reference substrate and production substrate colours, assuming that the primary difference between them lies in the colour of the substrates

3.16
system qualification
assessment operation used to qualify the ability of a print device or a printing process to reproduce a defined colour data set

Note 1 to entry: This qualification, also named "extended scrutiny", cannot usually be performed by print providers during production as it requires specific testing conditions and protocols.

4 Printing workflow requirements

4.1 Job colour definition

4.1.1 General

As illustrated in Figure 1, colour definition is the first step of a printing workflow. This is where a brand owner or a designer chooses the desired spot and visual colours for the printed product.

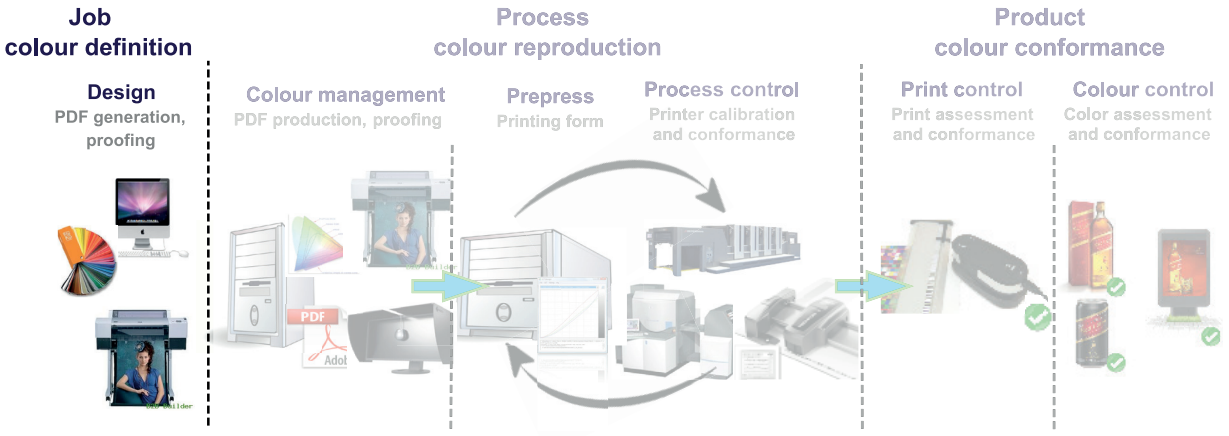

Figure 1 — Universal printing workflow — Job colour definition

4.1.2 Digital file creation

File format shall be mutually agreed between provider and receiver. The print service provider should provide its customers with a detailed specification detailing the technical properties of the digital files to be received (e.g. format, resolution, metadata, colour definition). If no agreement is present then files shall be prepared in conformity with the ISO 15930 series.

4.1.3 Graphic content

Print buyer specifications shall be clearly defined and mutually agreed on with the print service provider in terms of:

— reference printing condition (RPC);

— conformity (process, print, colour conformity, criteria, aims and tolerances).

4.1.4 Spot colour and device colour build

4.1.4.1 General

Spot colour definition is important because it is often associated with a brand or product identification. A specific colour can also be defined as a device colour build made of process colourant composite.

4.1.4.2 Spot and device colour for commercial printing

In commercial applications, spot colours shall be defined by colourimetric values (CIELAB, CIELCh) and should be defined by spectral values.

4.1.4.3 Spot and device colour for packaging printing

In packaging applications spot colours shall be defined by their spectral response curves.

4.2 Process colour reproduction

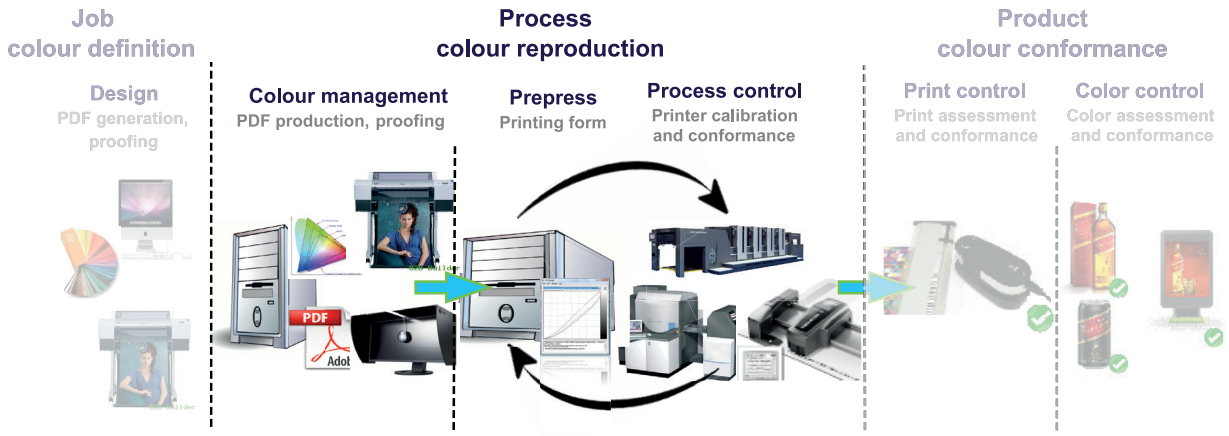

Figure 2 — Universal printing workflow — Process colour reproduction

As illustrated in Figure 2, the colour reproduction stage of a printing workflow can be divided into three main areas:

— colour management [adapting PDF RPC to actual printing condition (APC)];

— prepress (printing form preparation);

— process control (print device calibration and conformity).

4.2.1 Colour management

4.2.1.1 Digital file reception

The print service provider should perform a preflight check on files upon job file reception in order to identify print buyer expectations and intended printing conditions. Any concern shall be notified immediately to the print buyer.

To enable a reliable colour management, the following job file metadata should be available in PDF XMP fields or in another machine-readable file format:

— RGB or CMYK working colour space used;

— rendering intents;

— output intent.

4.2.1.2 Proof and validation print

Digital job files should be delivered with digital proofs that conform with the requirements of 5.1.3.2.

If the print service provider has applied any colour conversion or substrate colour correction on the received file in order to match RPC with APC, a new hard proof should be produced with this modified file.

Hard proof margin information shall clearly mention production date, proofing system information, date of last calibration, simulation profile or characterization data [including substrate-corrected colourimetric aim (SCCA) parameters: RPC, reference white point and actual white point].