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Graphic technology — Printing from digital data across multiple technologies —

Part 1:
Principles and characterized reference printing conditions

Technologie graphique — Impression à partir de données numériques via des technologies multiples —

Partie 1: Principes et conditions d'impression de référence caractérisées

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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.

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ISO 15339-1 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

ISO 15339 consists of the following parts, under the general title *Graphic technology — Printing from digital data across multiple technologies*

— *Part 1: Principles and characterized reference printing conditions*

Introduction

ISO 15339 is based on the premise that in the printing and publishing industry, electronic data is the intermediary for content storage and exchange throughout production including copy preparation, job assembly, proofing, and printing. It further assumes that data preparation can be largely process independent and that choice of the printing process or processes to be used for final production will be based primarily on run length requirements and substrates to be used. Each of the major printing processes has unique limitations that are covered in additional parts of ISO 15339. There are a variety of tools in place to both define the relationship of digital data to printed colour for specific instances of printing and to manipulate data such that common results can be obtained between and among different printing processes (ISO/TS 10128). These specific instances of printing are typically described by colour characterization data, which is the relationship between CMYK input data and colour measured on the printed sheet. Where such a set of colour characterization data is used as a reference (such as in this part of ISO 15339) it is referred to as a characterized reference printing condition.

When producing printed colour reproductions it is important that the organizations responsible for material preparation, colour separation, proofing, and printing are all working to a common set of parameters that uniquely define the intended visual characteristics of the final printed product. Such an agreement enables the correct production of suitable input data and subsequent production of proofs from these data. The purpose of a proof is to simulate the visual characteristics of the finished print product as closely as possible prior to production printing.

There is a unique relationship between ink, substrate, and printing process that limits the maximum chroma of the solids of the printing colorants and therefore limits the range of colours (colour gamut) that can be achieved for particular combinations. While special inks can be used, the commonly available ink pigments seem to be used across all wet ink processes. While toner and ink-jet systems have different colorant constraints than wet ink processes, they tend to mimic wet ink processes aims and they will be treated as a variation of wet ink processes. The achievable chroma range (gamuts) of ink-on-paper characterized reference printing conditions can generally be bracketed between cold-set printing on newsprint on the small end and by sheet-fed printing on gloss coated stock on the large end. Between these limits there is significant overlap of process/substrate combinations. The number of intermediate characterized reference printing conditions that are logical to define between smallest and largest is in part a function of the tolerances to which printing is expected to conform to the intended characterized reference printing condition. However, the intermediate characterized reference printing conditions also need to represent common widely used printing conditions and that was the determining factor for the selection of printing conditions listed in this part of ISO 15339. In addition a characterized reference printing condition 7 is included to represent a possible exchange space for digital printing data and/or other large gamut processes that exceed the colour gamut of characterized reference printing condition 6 and therefore need a larger exchange gamut.

The references that were used to create the various data sets are shown in Table 1.

A colour characterization data set is required for each characterized reference printing condition specified. Because these data sets can be used as the reference for any printing process, they will not be aligned with the typical TVI and trapping associated with any specific process. The values selected represent a compromise between all processes – in effect virtual printing on a virtual printing system.

It is important to realize that digital data can be encoded as already separated CMYK or can consist of un-separated data (typically in an RGB colour space) with supplementary information (ICC colour profiles, etc) defining the colour it is intended to be on the printed sheet. Such un-separated data plus the associated supplementary data is sometimes referred to as "virtual CMYK" data. All data is to be encoded according to one of the PDF/X specifications (Parts of ISO 15930) or TIFF/IT (ISO 12639) to allow the necessary metadata which identifies the intended characterized reference printing condition to be included.

Table 1 — Reference data sets used

CRPC	Name	US reference	European reference
1	Universal ColdsetNews	SNAP2009	IFRA 26
2	Universal HeatsetNews	BetaHeatsetNews	Fogra 42
3	Universal PremUncoated	BetaOffsetUncoated	Fogra 47
4	Universal SuperCal	BetaSupercal	Fogra 40
5	Universal PubCoated	SWOP2006_Coated 3,5	Fogra 45,46
6	Universal PremCoated	GRACoIL2006_Coated 1	Fogra 39
7	Universal Extra Large	Average of digital printers	

The colour of the printing substrate is a critical component of the colour appearance of a printed image (the 5th colour). With the current widespread use of optical brightening agents (OBA) substrate colour is defined in terms of its apparent reflectance under D50 illumination (see ISO 3664). For halftone images the colour of the substrate contributes mostly in the area not covered by ink. ISO 13655 provides a reasonably effective method to adjust tristimulus data of measured halftone areas for moderate changes in substrate colour. This part of ISO 15339 is based on the assumption that the colour characterization data can be adjusted (fine tuned) for the range of normal substrate colours expected and that different characterized reference printing conditions are not required for moderate differences in substrate colour.

Although density, tone value increase, gray balance, etc. are individually important tools for the printing and publishing industry, in this International Standard they are assumed to be part of process control and not printing definition. They need to be considered in developing reference colour characterization data sets and are indispensable as part of local site ongoing process control.

Gray balance in particular is a useful tool for the control of a running press. Modern characterization data and profile evaluation tools allow identification of the CMY values associated with the neutral (achromatic) tone scale and the single colour tone value scales for that colour characterization data set. Using the values derived from the colour characterization data, rather than any a priori values, is the recommended input for process control aims used to control a printing process intended to conform to a particular characterized reference printing condition.

Annex B provides a description of the process independent workflow that is the basis for the concepts embodied in this part of ISO 15339.

Graphic technology — Printing from digital data across multiple technologies —

Part 1:
Principles and characterized reference printing conditions

1 Scope

This part of ISO 15339 establishes principles for use of electronic colour content data as the intermediate storage and exchange media between copy preparation, job assembly, proofing, and graphic arts production printing. It specifies a limited number of characterized reference printing conditions that span the expected range of colour gamuts used for the production of printed material from digital data, regardless of printing process used. It also specifies the procedure to be used to adjust colour characterization data for the normally expected range of substrate colour.

2 Normative references

The following referenced documents are indispensable for the application 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/TS 10128, *Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data*

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

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

ISO 15076-1, *Image technology colour management — Architecture, profile format and data structure — Part 1: Based on ICC.1:2010*

3 Terms and definitions

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

3.1
colour characterization data
a tabulation of data that represents the relationship between device code values (eg:CMYK) and the colour (CIELAB) produced on the printed sheet by those values in a specific printing process

3.2
colour profile
a set of transforms, encoded according the rules of ISO 15076-1, that convert data between (to and from) device space and profile connection space

Note 1 to entry: The transforms contained within a colour profile can include manipulation of gamut compression/expansion, tone reproduction, colour separation, black printer creation, printing limitations (e.g. total data area), etc.

3.3
gamut
the (mostly convex) hull of the colour space defined by the CIELAB values of the primaries and secondaries along with the substrate in a printing process

Note 1 to entry: For comparison purposes the CIELAB values of the primaries and secondaries along with the substrate are often an adequate (sparse) definition of a colour gamut, although a more complete definition can be given by the surface values of the measurements of a target like the one contained in ISO 12642-2.

3.4
characterized reference printing condition (CRPC)
an identified printing condition and its colour characterization data that is used as the aim for a particular printing task (job)

3.5
process independent
independent of the printing process (offset, flexography, gravure, etc.) to be used for production of printed material

4 Requirements

4.1 Principles and assumptions

One of the key principles upon which this International Standard is based is that electronic tools exist that allow colour electronic content data to be adjusted such that any printing processes, that can achieve a specified colour gamut, can produce the within-gamut image colours specified by the appropriate reference colour characterization data. This allows printing aims to be process independent.

A second principle is that process control aims and tools should be based on the reference colour characterization data selected and not based on a priori assumptions. Many of the parameters used in process control such as tone value increase, gray balance, etc. are contained within, or can be derived from, the colour characterization data chosen as reference. Local site tools can also be used for initial setup processes, but these need to be based on the known differences between the colour characterization data aims and the colour characterization of the actual printing system being used.

Where similar characteristics, such as tone reproduction, are desired between different characterized reference printing conditions (different colour gamuts) these need to be built into the colour characterization data associated with these characterized reference printing conditions. Characterized reference printing conditions, and their associated colour characterization data, can be thought of as a virtual printing system (press) and as such the characterization data can be manipulated mathematically to fine tune results to achieve smoothness, uniformity and/or other characteristics.

The key requirement for successful application of these principals is that the reference colour characterization data and the characterization data for the printing system being used shall have the same gamut and the data steps shall have sufficient tonal steps that the data can be adjusted as necessary. (see ISO/TS 10128)

4.2 Data encoding

All electronic colour content data to be used as the intermediate storage and exchange media between copy preparation, job assembly, proofing, and printing shall be encoded in accordance with a part of ISO 15930 or as specified in ISO 12639.

Where colour content data is encoded in accordance with ISO 12639 it shall have the selected colour characterization data, or the appropriate pointers to the registry containing the colour characterization data, included in TIFF/IT TAG 34029. If some or all of the colour content data is not supplied in the process colour model of the characterized reference printing condition, a colour profile shall be included using TIFF/IT TAG 34675 which shall be used to transform the colour content data provided into the process colour model of the characterized printing condition.

4.3 Data preparation

All print elements shall be prepared as either output device code values or as colorimetrically defined data. However, both types of data, if present in print elements, shall be prepared for a single characterized reference printing condition identified in the PDF/X output intent. Unless otherwise agreed between sender and receiver, the characterized reference printing condition identified shall be one of the data sets defined in 4.4.

4.4 Characterized reference printing conditions and colour characterization data

4.4.1 General

Colour characterization data is the relationship between CMYK data and printed colour (intended or measured). Many profiles (all equally valid) can be based on a single set of characterization data. Therefore characterization data is used to define the expected printing parameters and the relationship between the device values provided (real or virtual) and the colour expected on the printed substrate.

The use of colour profiles is an important part of the data preparation process and colour profiles with specific characteristics are often specified by industry trade associations to restrict and provide more commonality in user input. However, they are not appropriate for standardization.

4.4.2 Characterized reference printing conditions

The characterization data sets associated with the characterized reference printing conditions identified in this part of ISO 15339 are included as data files ISO15339-RPC-1.csv through ISO15339-RPC-7.csv. The CIELAB a*-b* projection of the colour characterization data of each of these characterized reference printing conditions is shown in Figure 1.

It is important to note that these characterized reference printing conditions are based on the ink colours and 2-colour overprints defined in the various parts of ISO 12647 with corrections for substrate colour differences. However, for alternate printing processes that do not use colorants that align with the hue angles of these characterization data sets, these colour values may be simulated by the appropriate combination of the colorants available, assuming the colour gamut of those colorants encompasses the gamut of the characterized reference printing condition selected. For convenience this part of ISO 15339 will continue to refer to single-colour solids, two-colour overprints, etc recognizing that alternate printing systems may simulate these values using appropriate combinations of available colourants.

All colorimetry should be measured, according to ISO 13655 M1 with white backing. If M1 measured data is not available, M0, data converted to M1 is sufficient. M1 data over white backing shall be provided..

The substrate, single colour solids, and two-colour overprints that are the aims for the characterization data set shall be as shown in Table 2 and Table 3.

The colorimetrically computed TVI for each of the single colour scales of each of the characterized reference printing conditions is listed in Table 4 for information.

