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Graphic technology — Printing from digital data across multiple technologies —

Part 1:
Principles

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

Partie 1: Principes

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is 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*

— *Part 2: Characterized reference printing conditions, CRPC1- CRPC7*

Introduction

ISO 15339 series is based on the premise that in the printing and publishing industries, electronic data is the intermediary for content storage and exchange throughout production, including copy preparation, job assembly, proofing, and process colour 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. There are various 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 similar 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, it is referred to as a characterized reference printing condition (CRPC).

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 colourants 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 are used across all traditional ink processes. While toner and ink-jet systems have different colourant constraints than traditional ink processes, they tend to mimic traditional ink process aims and they will be treated as a variation of traditional ink processes. The achievable chroma range (gamut) of ink-on-paper characterized reference printing conditions can generally be bracketed between cold-set printing on newsprint on the small end and by printing on gloss coated stocks (by a variety of processes) 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 and that was the determining factor for the selection of the characterized reference printing conditions listed in ISO 15339-2. In addition, a characterized reference printing condition 7 is included to represent a possible exchange space for large gamut processes that exceed the colour gamut of characterized reference printing condition 6 and therefore need a larger reference gamut.

The data sets defined in ISO 15339-2 are those associated with the initial publication of ISO 15339 series. It is the intent of ISO TC 130 that if changes in, or additions to, these data sets are needed in the future, they will be documented in added parts of ISO 15339 series so that changes in the data sets, or addition of data sets, are possible without losing traceability to earlier data sets.

A colour characterization data set is required for each characterized reference printing condition specified. Because the intent of ISO 15339 series is that the data sets provided can be used as the reference for any printing process, they might not be aligned with the typical TVI and trapping associated with any specific printing process. The values selected need to represent a compromise between all potential processes to be used — 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 intended on the printed sheet. Such unseparated 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) to allow the necessary metadata which identifies the intended characterized reference printing condition to be included.

The colour of the printing substrate is a critical component of the colour appearance of a printed image (it behaves like a fifth 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. 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, grey balance, etc. are individually important tools for the printing and publishing industry, in this part of ISO 15339, 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 need to be used where applicable as part of local site ongoing process control.

Modern characterization data and profile evaluation tools allow identification of the colour of the solids, the colour and tone values of the single colour scales, and the CMY values associated with the neutral (achromatic) tone scale. 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 C provides a description of the process independent workflow that is the basis for the concepts embodied in ISO 15339 series.

Graphic technology — Printing from digital data across multiple technologies —

Part 1: Principles

1 Scope

This part of ISO 15339 establishes principles for the use of colour characterization data as the definition of the intended relationship between input data and printed colour for copy preparation, job assembly, proofing, and graphic arts production printing. Additional parts of ISO 15339 specify a limited number of characterized reference printing conditions that span the expected range of colour gamut used for the production of printed material from digital data, regardless of the printing process used. The procedure to be used to adjust colour characterization data for the normally expected range of substrate colour is specified.

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/TS 10128, *Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data*

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

3.2
colour characterization data
tabulation of data that represents the relationship between device code values (e.g. CMYK) and the colour (CIELAB) produced on the printed sheet by those values in a specific printing process

3.3
colour profile
set of transforms, encoded according to the rules of ISO 15076-1, that convert data between (to and from) device space and profile connection space

Note 1 to entry: 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 area coverage), etc.

3.4
gamut
region of CIELAB colour space containing all printable colours

Note 1 to entry: For comparison purposes, the CIELAB values of the primaries and secondaries, along with the substrate, are often an adequate, if sparse, definition of a colour gamut. The surface values of the measurements of a target, such as that included in ISO 12642-2, can provide a more complete definition.

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

3.6
identified printing condition
printing condition documented in a national or International Standard or industry publication in a way that allows it to be replicated by an industry practitioner

4 Requirements

4.1 Principles and assumptions

One of the key principles upon which this part of ISO 15339 is based is that colour content data can be adjusted such that any printing processes, capable of achieving 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 (extracted from) 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, grey 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 gamut), 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 be sufficient to allow the necessary data adjustment. (See ISO/TS 10128 for recommended procedures to implement such data adjustment.)

4.2 Data encoding

In the absence of other prior agreement, 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. Any deviation from this, such as encoding in ISO 12639 or in some other format, shall be according to prior agreement by all parties and shall include communication of the reference characterization data of the intended printing condition and, as necessary, a colour profile to transform any data not supplied in the process colour model of the reference.

4.3 Data preparation

All print elements shall be prepared either as device code values or as colourimetrically-defined data. However, both types of data, if present in print elements, shall be prepared for a single characterized reference printing condition. This condition shall be provided in the PDF/X output intent in the case of an ISO 15930 exchange or shall be communicated by mutually agreed upon methods in other situations. Unless otherwise agreed between sender and receiver, the characterized reference printing condition shall be one of the data sets defined in a part of ISO 15339.

4.4 Characterized reference printing conditions and colour characterization data

The characterized reference printing conditions associated with ISO 15339 are contained in additional parts of ISO 15339. This approach was taken to allow ISO TC 130 to change or update characterized reference printing conditions without revising or invalidating characterized reference printing conditions that might have been used as the basis for existing printing work.

The data sets defined in ISO 15339-2 (CRPC 1-7) are those associated with the initial publication of ISO 15339 series.

NOTE If changes in, or additions to these data sets are needed in the future, they can be documented in added parts of ISO 15339 and carry new CRPC designations. When additional CRPCs are published in subsequent parts of ISO 15339, it is expected that they will follow the same sequential naming scheme to avoid confusion, i.e. 15339-CRPC-8 would be the next named data set.

For alternate printing processes that do not use colourants that align with the hue angles of a characterization data set, the colour values may be simulated by the appropriate combination of the colourants available, assuming the colour gamut of those colourants 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 might simulate these values using appropriate combinations of available colourants.

All colourimetry should be measured according to ISO 13655 M1 with white backing. Where the substrate is non-fluorescent, M1 data are identical to M0 data and M0 data may be used as M1 data. If M1 data is not available, M0 data converted to M1 is sufficient (see Annex A).

The measurement conditions and intended interpretation of all colourimetric data provided as part of ISO 15339 CRPCs (ISO 15339-2 and future parts) shall be defined in the part of ISO 15339 in which the data appears.

The characterized reference printing conditions shown in ISO 15339-2 have been selected to be near the middle of both the general class of printing that is expected to make use of each characterized reference printing condition and the colour of the substrates used. It is expected that adjustments for substrate colour (see 4.6) will allow each characterized reference printing condition to meet a wide variety of needs and be independent of the printing process to be used.

4.5 Use selection criteria for choice of characterized reference printing condition

It is anticipated that the printing industry (with support from the ink and paper organizations) will begin to develop tables of substrate types and printing processes that will support and/or be most appropriate for each of the characterized reference printing conditions. Where the same content is to be reproduced by more than one process or on more than one substrate, a gamut common to the multiple needs should be selected. Where only a single substrate and printing system is to be used, the typical choice should be the largest gamut that choice will support.

The chosen characterized reference printing condition shall be used as the basis for design and content creation.

Communication of the intended printing condition between all parties (preparation, proofing, and printing) only needs to identify ISO 15339 and the gamut to be used along with information relating to any limitations of the intended printing process that need to be considered during preparation, proofing, or printing.

Not all printing processes that can achieve the same colour gamut are subject to the same limitations. Offset, gravure, flexography, electrophotographic, ink-jet, etc., each have limitations that might have to be considered in the final data preparation for printing. These typically include limitations of total ink coverage, minimum and maximum printable dot sizes, etc.

NOTE If general guidance is needed, additional parts of ISO 15339 can be prepared to assist in the communication or standardization of the handling of such limitations.

4.6 Adjustment of data for substrate colour differences

The characterization data contained in ISO 15339-2 are all based on the CMYK characterization target defined in ISO 12642-2. The substrate colour is therefore given in data element 1 of each data set.

Where the printing substrate to be used has a colour that differs from that of the reference printing condition selected for data preparation and data exchange, correction of the data for such differences can be beneficial. The use of a single method to accomplish correction enhances the ability of different users to achieve similar results. Annex A provides one conversion method that produces reasonable results for halftone type images. Where substrate adjustment is done this fact, the method used (if other than Annex A) and the values of the intended substrate shall be communicated to all involved.

Where the printing substrate to be used has a colour that differs from that of the reference printing condition selected for data preparation and data exchange by less than 2 CIEDE2000, the user can elect to use the data without modification.

Where the printing substrate to be used has a colour that differs from the characterized reference printing condition selected for data preparation and data exchange by more than 2 but less than 5 CIEDE2000, the method defined in Annex A (see also ISO 13655) should be used to adjust the data before proofing and printing.

Where the difference in substrate colour is greater than 5 CIEDE2000, this correction may be used but the user is cautioned that special colour characterization data might be required which is beyond the scope of ISO 15339 series.

NOTE When data adjustment is done using the tristimulus correction technique defined in Annex A, the colour values of all data points in the colour characterization data set are changed — including the aim values for the single-colour solids.

Where characterization data is exchanged that has been modified for changes in substrate colour, it can no longer be simply referenced as ISO 15339-CRPCx. Where the exchange between participants is not a blind exchange, agreements concerning the substrate to be used and the substrate correction can be exchanged and included in private metadata. For blind exchange, it can be treated as an alternate printing reference (see 4.7).

4.7 Alternate printing reference

Where one of the sets of reference colour characterization data defined in the additional parts of ISO 15339 are not appropriate for the intended printing because of the inks, paper, or printing process to be used, prior agreement should be obtained between all parties involved before copy preparation work is started and the colour characterization data to be used and any colour management profiles shall be communicated with the job content files.

