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(Identical National Adoption of
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AMERICAN NATIONAL STANDARD

Graphic technology — Input data for characterization of four-colour process printing — Part 1: Initial data set

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Contents

Page

Foreword

ANSI CGATS/ISO 12642-1(IT8.7/3) is an identical adoption of ISO 12642-1:2011. ISO 12642-1:2011 was prepared by ISO Technical Committee 130, Graphic technology, with the support of the ANSI Committee for Graphic Arts Technologies Standards (CGATS).

Minor edits have been made to this standard to prepare it as an ANSI CGATS standard. No technical changes have been made.

The CGATS consensus body approved the national adoption of ISO 12642-1 for issuance as CGATS/ISO 12642-1(IT8.7/3) in accordance with the ANSI Procedures for the National Adoption of ISO and IEC Standards as American National Standards and the CGATS Operating Procedures.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. Neither ISO, ANSI nor CGATS shall not be held responsible for identifying any or all such patent rights.

Introduction

0.1 General background

The technical content of this part of ISO 12642 is identical to ANSI IT8.7/3-1993. The ANSI document resulted from the joint efforts of an international industry group that included participants representing a broad range of prepress vendors, film manufacturers, and users. This group, initially identified as the DDES (Digital Data Exchange Standards) Committee, later became the founders of the ANSI IT8 (Image Technology) accredited standards committee which is responsible for electronic data exchange standards in graphic arts prepress.

In an environment in which colour information is passed between electronic publishing systems, it is essential for colour to be defined in an unambiguous manner. Substantial experimental evidence enables us to conclude that, for foveal vision, this can be achieved by specifying the mixture of three linearly independent stimuli required to match that colour. In 1931 a complete system of colour definition was developed by the CIE (Commission Internationale de l'Eclairage) based on experimental evidence published during the previous decade. This evidence confirmed the similarity between observers in making such a match. That system and its derivatives are now universally accepted for colour specification.

Many half-tone colour printing processes, however, require more than three colourants. There are two reasons for this. Generally the gamut of colours achievable with three printing inks is rather limited, and printing additional inks can extend the gamut significantly. Furthermore, the provision of extra inks can reduce the magnitude of the visual change caused by the variability in colour and register which arises in print production. By far the most common additional ink used is black, and four-colour process printing is accepted as the norm for most forms of printing.

The addition of an extra ink means that the production of a colour cannot, in general, be defined uniquely. As a result, different parts of a printed sheet can use varying ink combinations to achieve the same colour. For many practical purposes it is desirable to specify this combination directly, rather than encode it by rules, and this leads to the requirement to transfer data in a four-colour, device-specific mode. If the same data are to be used for other applications, or even if it needs to be modified for a different set of printing characteristics, some additional information is necessary to enable the receiver of the data to interpret it. This part of ISO 12642 has been developed to achieve this objective. It provides a data set which can be transmitted with an image to enable the receiver, if required, either to transform the data into a device-independent state or correct it for a different printing characteristic. An alternative application of the tools provided by this part of ISO 12642 is to enable the characterization of output systems; in this context, work has been undertaken by the committee to generate data for the major types of half-tone printing processes which have been specified internationally. This procedure is described in the application notes (Annex A) and the data will be published in future annexes.

The body of this part of ISO 12642 defines the ink values to be used for characterizing any four-colour (cyan, magenta, yellow, and black) half-tone printing process (including gravure). These ink values are defined as either digital data in a computer or half-tone tone values on film. This requires that particular care be taken in the preparation of film to ensure that the output device is properly “linearized” and the half-tone film values match the numerical data in the computer file. For some applications the film values used for linearization can be one or more generations removed from the film produced by the film writer. The measurement procedures and the data format to be used in determining and reporting tristimulus values (X,Y,Z) are also included.

While the technique employed in this part of ISO 12642 applies to all output processes, the data have been optimized for four-colour half-tone printing. For non-half-tone processes, or those which use colourants that are significantly different from typical printing inks, it is advisable that the reference data file be determined in such a way that it provides reasonably uniform colour differences when the data file is rendered. For a system which does not meet the criterion, the user-optional data set can be utilized. Suggestions for this are made in the application notes; however, they are not part of this part of ISO 12642.

Note that this part of ISO 12642 does not define the physical layout of the patches or their size. This is because any such decision depends on the printing device to be used, and the area required for colour measurement. It is anticipated that a specific layout will be produced to suit the needs of the user. However, in order to realize the colours necessary for the measurements of specific printing processes to be included as future annexes, it was necessary to produce a specific layout. This layout, composed of four groups of patches, has been adopted by both ANSI/CGATS and ISO/TC 130. Within TC 130 the digital data in the appropriate format are contained in images S7 to S10 of the Standard Colour Image Data (SCID), ISO 12640-1:1997. For the guidance of others, this layout is shown in Figure A.1.

0.2 Technical background

0.2.1 Printing characteristics

Various efforts have been made over the past 20 years to reduce the variation which occurs between printing presses. Initially, standards such as ISO 2846 were developed to specify the colour of printing inks. Subsequently, as a result of the lead of FOGRA/BVD in Germany, significant effort has been made in developing specifications which define constraints for the ink transfer onto paper. This is achieved by specifying either the reflection density or the tristimulus values of a uniform (solid) printed ink film, and by specifying tolerances on the optical density (i.e. dot value) of various half-tone dot values. Within the international printing community such specifications are widely recognized and have become, in many cases, de facto printing standards. For magazine and periodical printing, SWOP (in the USA) and FIPP (in Europe) are widely recognized standards. For commercial printing, the specifications of FOGRA and PIRA are widely known in Europe. Specifications are also evolving for newspaper and heat-set web production. Future annexes to this part of ISO 12642 might contain the colorimetric tristimulus values corresponding to these percent dot values when printed in accordance with a number of such printing specifications. Such data can be used as the basis for the conversion between ink values and tristimulus values.

Note that any characterization of the process takes account of all steps involved in print production. Thus it includes production of the separations, any contacting operations that might be required and platemaking. All of the printing specifications as referred to above include recommendations for maintaining consistency of such operations to ensure that validity of a characterization is maintained.

For characterizing printing conditions which differ from the published specifications, two options exist. Either the large palette of colours can be printed and measured, or the process can be modelled analytically. The analytical modelling approach has the advantage of requiring far fewer colour measurements; the disadvantages lie in the accuracy of prediction. For many applications, a satisfactory compromise is achieved by using modelling for the modification of published data. This is discussed in more detail in the application notes.

0.2.2 Choice of colour palette

It is generally agreed that measurement of a reasonably large number of colours is preferred for accurate characterization of any printing process. It is not possible to be precise about how many colours are required; the number will depend on many factors including the accuracy of colour rendition required, the uniformity of spacing of the samples in terms of colour, the type of modelling process used, and any nonlinear characteristics of a specific printing process. However, practical experience suggests that measuring all combinations of six levels each for cyan, magenta, yellow, and black, preferably weighted towards lower half-tone dot values, will frequently prove adequate. Generally, for higher levels of black, the number of samples can be considerably reduced, since the colour difference between samples is very small. With the addition of single colour scales which contain extra values to assist in defining local nonlinearity, the accuracy obtained for most printing processes is adequate.

A reduced-size data set can be used if:

— a less accurate characterization is adequate;

— the process can be modelled accurately by one of the well-known models listed in the application notes;

— the aim of the measurement is to seek small corrections to an already accurate characterization.

The advantages of this approach are that the measurement effort is substantially lower and that the file size of the data is greatly reduced. This can be advantageous when images are compressed although, in general, even the larger file is small compared to most images.

The proposal accepted for this part of ISO 12642 defines a colour palette consisting of 928 combinations of cyan, magenta, yellow, and black ink values. It is this palette (hereafter called the extended ink value data set) which has been measured to provide colour characterization data on the major printing specifications.

Where such an extensive set of data is not required, a subset of this palette which consists of 182 colours (hereafter called the basic ink value data set) is specified. It provides data suited to a variety of modelling methods and generally provides excessive data for any specific method. It is sufficient for almost all published modelling methods.

For a characterization which cannot be achieved with the data sets defined in this part of ISO 12642, provision is made for a user-optional set of any size. The format of the data is defined in this part of ISO 12642.

It is anticipated that the basic data set will be the default file supplied in the header of image files to be exchanged, and that by prior agreement, one of the larger palettes can be provided when required. It is the intent of ANSI IT8/CGATS and of ISO/TC 130 to work with those organizations responsible for various printing definitions (SWOP, FOGRA, etc.) to develop tables of colour data that are agreed to be representative of the named printing conditions. When such data are available and published by ISO, they can be referenced as “named” data. Where such named data are identified, they can be used by the receiver and the file need not be sent. For many applications it is expected that the use of named data sets will suffice.

ISO 12642-2 is both a newer and larger data set and is currently preferred over this part of ISO 12642 for characterization of graphic arts printing. However, this part of ISO 12642 is essential for the documentation and validation of earlier characterization data.

Graphic technology — Input data for characterization of four-colour process printing — Part 1: Initial data set

1 Scope

This part of ISO 12642 defines an input data file, a measurement procedure and an output data format for use in characterizing any four-colour printing process.

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

ISO 28178, *Graphic technology — Exchange format for colour and process control data using XML or ASCII text*

3 Terms and definitions

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

3.1
CIE tristimulus values
amounts of the three reference colour stimuli, in the CIE-specified trichromatic system, required to match the colour of the stimulus considered

NOTE In the 1931 CIE standard colorimetric system, the tristimulus values are represented by the symbols X, Y, Z.

3.2
colour gamut
subset of perceivable colours reproducible by a device or medium

3.3
half-tone dots
dots which vary in spatial frequency or size, thereby producing an image of tonal gradation

NOTE Half-tone dots are normally quantified by the percentage area they cover. Measurement of dot area is normally made on film separations and is derived from the Murray-Davies equation.

3.4
keyword value file
file that makes use of predefined keywords and data tables to exchange data in an open extensible manner

3.5
process colour printing
reproducing colour images using three or more printing inks

NOTE The normal process inks consist of cyan, magenta, yellow, and black.