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Graphic technology - Input data for characterization of 4-colour process printing - Part 1:  
Initial data set

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**ICS:**

35.240.30	Uporabniške rešitve IT v informatiki, dokumentiranju in založništvu	IT applications in information, documentation and publishing
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# INTERNATIONAL STANDARD

**ISO**  
**12642**

First edition  
1996-12-15

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## Graphic technology — Prepress digital data exchange — Input data for characterization of 4-colour process printing

*Technologie graphique — Échange de données numériques de  
préimpression — Données d'entrée pour caractérisation d'impression en  
quadrichromie*

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Reference number  
ISO 12642:1996(E)

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International Organization for Standardization  
Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12642 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

Annexes A and B of this International Standard are for information only.

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## Introduction

### General background

The technical content of this International Standard is identical to the American National Standard 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 in 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 may 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 is 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 International Standard 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 pro-

vided by this International Standard is to enable the characterization of output systems and 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 International Standard 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 may 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 International Standard applies to all output processes, the data has 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, the reference data file should 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 could be utilized. Suggestions for this are made in the application notes; however, they are not part of this International Standard.

It should be noted that this International Standard 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 is contained in images S7 through S10 of the Standard Colour Image Data (SCID), ISO 12640. For the guidance of others, this layout is shown in figure A.1.

## Technical background

### 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 around an optical density at which various half-tone dot values should be reproduced. 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 International Standard may 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.

It should be noted 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 which may 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 that it requires 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.

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### 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 may 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 may 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 International Standard 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 International Standard, provision is made for a user-optional set of any size. The format of the data is defined in this International Standard.

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 may 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, such data can be referenced as "named" data. This means the published data should 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.

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# Graphic technology — Prepress digital data exchange — Input data for characterization of 4-colour process printing

## 1 Scope

This International Standard 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 standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange*.

ISO 12640:—<sup>1)</sup>, *Graphic technology — Prepress digital data exchange — Standard colour image data (SCID)*.

ISO 13655:1996, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*.

## 3 Definitions

For the purposes of this International Standard, the following 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. 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.

1) To be published.

**3.5 process colour printing:** Reproducing colour images using three or more printing inks. The normal process inks consist of cyan, magenta, yellow, and black.

**3.6 ink value:** Digital file value which represents the amount of a colourant required in a rendering process. For the half-tone printing process this is equivalent to the dot area of the half-tone film expressed as a percentage.

**3.7 white space:** Space in a data file occupied by characters which do not print. Typical examples are space (position 2/0 of ISO/IEC 646), carriage return (position 0/13 of ISO/IEC 646), newline (position 0/10 of ISO/IEC 646), and tab (position 0/9 of ISO/IEC 646).

## 4 Requirements

### 4.1 Data set definition

Two sets of ink values are specified which span, with differing intervals, the colour space defined by combinations of cyan, magenta, yellow, and black dot area percentages. The basic data set, which is a subset of the extended data set, shall be the default set in the absence of any other information; the extended data set (or subsets of it) may be used if specified. The data is defined as digital data and does not exist as printed images (or sets of separations). However, the colorimetric values needed to produce the colour characterization data file may be determined by printing images which have been made from films containing half-tone values corresponding to the values in the ink value data set.

#### 4.1.1 Basic ink value data set

The cyan, magenta, yellow, and black ink values specified in this set, and their identification (ID) numbers, shall be as listed in table 1.

NOTE — The sample location information included in table 1 is based on the printing layout shown in figure A.1 and is included for information only.

#### 4.1.2 Extended ink value data set

The extended data set shall include the values of table 1 as well as those of table 2.

NOTE — The sample location information included in table 2 is based on the printing layout shown in figure A.1 and is included for information only.

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