
**Graphic technology — Prepress digital data
exchange — CMYK standard colour image
data (CMYK/SCID)**

*Technologie graphique — Échange de données numériques de
préimpression — Données d'images en couleur CMYK normales
(CMYK/SCID)*



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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
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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.

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 12640 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

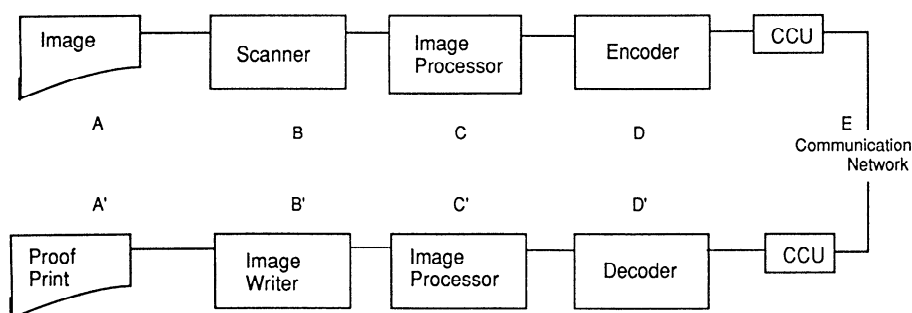
Annexes A and B form an integral part of this International Standard. Annex C is for information only.

Introduction

The initial technical content of this International Standard was coordinated by the Image Processing Technology Standard Committee in Japan as input to, and in coordination with, ISO/TC130/WG2.

Need for standard digital test

The following figure shows a block diagram of the typical functions that may be involved in the preparation of images for graphic arts reproduction. Not all current systems have coding or communication functions, and the read/write operations are frequently executed by devices installed at the same site. However, when considering the need for and development of these test images, the expert group considered systems that do include all the functions of image processing, data storage, encoding and transmission of data.



High-quality image reproduction and transmission system

The typical systems evaluation path would normally involve scanning a test image at point A and monitoring the characteristics or change in characteristics of that image at each stage of the system. However, the differences between scanners make it nearly impossible to repeatably create the same data file from a reference image on film. Such differences would make it impossible to compare other performance characteristics between systems or between sites.

To resolve this, a set of suitable test images was created that can be provided in digital form, to be used at every site regardless of the type of equipment used. Performance of any stage of the process (except of course input scanning) can thus be evaluated by comparing the image data before and after processing or by evaluating the effect of different processes on the final output. ISO 12641, *Graphic technology - Prepress digital data exchange - Colour targets for input scanner calibration*, provides targets for the evaluation and/or characterization of the scanning process itself.

The following are examples of typical uses of these images.

- The objective comparison of colour output systems such as printing, colour proofing, and colour facsimile. These comparisons may include evaluation of image processing times and system efficiencies as well as image quality, colour fidelity, etc.
- The evaluation of the effect or efficiency of coding schemes, data compression, and/or data transmission.
- The characterization of printed output from both traditional processes and direct digital output devices.

It is believed that these images will find application in many industries, in addition to graphic arts, where quality would be influenced by data transmission, image processing, storage, and recording.

Characteristics of test images

The performance of any colour reproduction system will be evaluated both subjectively (by viewing the final output image) and objectively by measurement of control elements. This dictated that the test images include both natural scenes (pictures) and control targets.

Because the results of subjective image evaluation are strongly affected by the image content it was important to insure that the natural images were of high quality and contained diverse subject matter.

Development of digital test images

A survey was conducted of all TC130 member countries to identify desirable image content and to solicit submission of suitable images for consideration.

The image set that resulted consists of 8 natural and 10 synthetic images. The natural images include flesh tones, images with detail in the extreme highlights or shadows, neutral colours, colours in the brown and wood tone area which are difficult to reproduce, memory colours, complicated geometric shapes, fine detail, and highlight and shadow vignettes.

The synthetic images selected include resolution charts, uniform vignettes in both the primary and secondary colours, and a physical representation of the CMYK data set defined in ISO 12642 for the characterization of 4-colour process printing.

The eight colour pictures were converted to CMYK digital data using a graphic arts colour scanner with scanning parameters optimized for each image to allow common reproduction aims. The five resolution charts and five colour charts were generated electronically.

In order to meet the needs of the widest graphic arts community, two resolution/data encoding combinations were selected for all images. Both are pixel interleaved data with the data origin at the upper left of the image, as viewed naturally, and organized by rows. The first set has a data spacing of 16 pixels per millimetre and a data encoding of 28 to 228 representing 0% to 100% printing values. The second set has a data spacing of 12 pixels per millimetre (approximately 300 pixels per inch) encoded with digital data of 0 to 255 representing 0 to 100% printing values.

These data are available on a CD-ROM formatted in accordance with ISO 9660. The file format is TIFF/IT as defined in ISO 12639. This file format is also compatible with TIFF Revision 6, Section 16, and can be imported and manipulated as necessary by a wide variety of commonly used imaging software packages on platforms in general use in the industry.

It should be noted that the grey balance of these images is self-consistent, but may not be optimum for any particular printing condition. The user is urged to use these images 'as is' as a tool to understand the reproduction characteristics of various processes. There is no 'correct' reproduction.

Graphic technology — Prepress digital data exchange — CMYK standard colour image data (CMYK/SCID)

1 Scope

This International Standard specifies the CMYK digital data that represents a set of standard colour images to be used for evaluation of changes in image quality during coding, image processing (including transformation, compression and decompression), film recording or printing which can be used for research, development, product evaluation, and process control.

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 ISO maintain registers of currently valid International Standards.

ISO 9660:1988, *Information processing - Volume and file structure of CD-ROM for information interchange*.

ISO/IEC 10149:1995, *Information technology — Data interchange on read-only 120 mm optical data disks (CD-ROM)*.

ISO 12639: ____ 1), *Graphic technology - Prepress digital data exchange - Tag image file format for image technology (TIFF/IT)*.

ISO 12642:1996, *Graphic technology - Prepress digital data exchange - Input data for characterization of 4-colour process printing*.

ISO 14672: ____ 1), *Graphic technology - Prepress digital data exchange - Statistics of SCID images*.

3 Definitions

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

3.1 check sum: Sum of the digits in a file that can be used to check if a file has been transferred properly.

NOTE 1 Often, only the least significant bits are summed.

3.2 colour sequence: Order in which colours are printed on a substrate or stored in a data file.

3.3 colour value: Numeric values associated with each of the pixels.

3.4 data range: Range of numeric digital values over which the data is specified.

3.5 dot percentage: Percentage of an area covered by halftone dots, ranging from 0% to 100%.

NOTE 2 The lightest areas of an image are represented by the smallest coverage, at or near 0%, while the darkest image areas consist of dots near maximum coverage of 100%.

3.6 global colour change: Change in the relationship of colours in an image applied consistently to all parts of the image as contrasted to a local colour change where selected spatial areas of an image are changed separately from the rest of the image area.

3.7 input colour scanner: Device capable of converting the light reflectance or transmittance of a photographic (or other hardcopy) sample into an electronic signal - where the electronic signal is arranged to have an organized relationship to the spatial areas of the image evaluated.

3.8 orientation: Specifies the origin and direction of the first line of data, with respect to the image content as

1) To be published

viewed by the end user. The codes used to specify orientation are contained in ISO 12639.

3.9 pixel: Smallest element in a digital imaging system.

3.10 pixel interleaving: Colour data organized such that the cyan, magenta, yellow and black colour values for one pixel are followed by the same sequence of colour values for the next pixel. The specific order of colours is determined by the ColorSequence tag as defined in ISO 12639.

NOTE 3 Other forms of colour data interleaving are line and plane.

4 Requirements

This International Standard consists of the data recorded on the CD-ROM bearing the title "ISO 12640, Graphic technology - Prepress digital data exchange - CMYK standard colour image data (CMYK/SCID) - Annex A - Standard colour image digital data" which is part of this International Standard. The image characteristics of these data are described in clause 5 and the electronic data structure in clause 6.

5 Data description and definition

5.1 Data resolution

The data set is provided at two different combinations of digital data encoding range and resolution. The primary set has a data range of 28 to 228 corresponding to dot percentages of 0% to 100% and has a data spacing of 16 pixels/mm (406 pixels/in) at the intended image size (128 mm by 160 mm). The alternate set has a data range of 0 to 255 corresponding to dot percentages of 0% to 100% and has a data spacing of 12 pixels/mm (305 pixels/in) for the same image size.

The alternate set was generated from the primary set by means of an analytical transform rule. Both sets contain the same pictures except that each image in the alternate set has "ISO 300" in small size text added to the top of the image in order to distinguish it from the primary set that has "ISO 400".

5.2 Data set definition

Each set of primary and alternate standard colour image data consists of eight natural (photographed) images and ten synthetic images created digitally by a computer. The natural images in the primary set are identified as N1 to N8, respectively. The letter "A" is added to the images in the alternate set (e.g. N1A). Each of these also has a descriptive name derived from the picture content (e.g. Cafeteria).

The synthetic images consist of resolution charts and colour charts. They are identified as S1 to S10 for the primary set and S1A to S10A for the alternate set.

5.2.1 Natural images

The characteristics and typical usage of the natural images are contained in table 1. The descriptive names of these images are given following the identification code. Figure 1 shows reduced monochrome reproductions of the natural images. Additional information concerning the statistical characteristics of these images is contained in ISO 14672. The natural images have the following characteristics:

Picture size

Primary set:

2 560 pixels(long side) by 2 048 pixels(short side)

Alternate set:

1 920 pixels(long side) by 1 536 pixels(short side)

NOTE 4 This corresponds to a physical image size of 160 mm by 128 mm or 6,3 in by 5,04 in when rendered at the recommended resolution of 16 pixels/mm for the primary set or 12 pixels/mm for the alternate set.

Interleaving :

Pixel interleaving

Colour sequence:

C (Cyan), M (Magenta), Y (Yellow) and K (Black).

Colour values

Primary set:

8-bit binary data scaled linearly with respect to the printing dot percentage, where a digital code value of 28 corresponds to 0% and 228 corresponds to 100% .

Alternate set:

8-bit binary data scaled linearly with respect to the printing dot percentage, where a digital code value of 0 corresponds to 0% and 255 corresponds to 100% .

Image data orientation :

Horizontal scanning starting from top left and ending at bottom right.

NOTE 5 The encoding of these data in the headers of the individual files is illustrated in annex C, and is in accordance with the formats specified in ISO 12639.

5.2.2 Synthetic images - resolution charts

Synthetic images, S1 to S5 and S1A to S5A, are resolution charts. These are used to evaluate the resolving power of output devices, registration accuracy of separations, moiré and aliasing effects. There are five patterns consisting of a quarter of a sunrise or star target with each ray separated by 4 degrees. Each pattern is 400 pixels square for the primary set and 300 pixels square for the alternate set. The size achieved at these resolutions is 25 mm square. The numeric values of all four separations are identical.

Table 1 - Natural images

Name	Aspect	Characteristics
N1 Portrait	Portrait	Closeup image of model used to evaluate the reproduction of human skin tones.
N2 Cafeteria	Portrait	Image with complicated geometric shapes. Suitable for evaluating the result of image processing.
N3 Fruit Basket	Landscape	Image of a fruit basket, cloth and wood used to evaluate the reproduction of brown colours and fine texture.
N4 Wine and Tableware	Landscape	Image of glassware and silverware used to evaluate the reproduction characteristics of highlight tones and neutral colours.
N5 Bicycle	Portrait	Image of a (penny-farthing) bicycle, resolution charts and other items containing fine detail used to evaluate the sharpness of reproduction and the results of image processing.
N6 Orchid	Landscape	Image of an orchid with background vignettes used to evaluate reproduction of highlight and shadow vignettes.
N7 Musicians	Landscape	Image of three women used to evaluate the reproduction of different skin tones and fine image detail.
N8 Candle	Landscape	"Low-key" image of a room scene containing miscellaneous objects used to evaluate dark colours, particularly browns and greens.

The values of S1 and S1A change sinusoidally, so that the smoothness of density change, and reproduction of middle tones can be evaluated. The S1 and S1A patterns were generated to complete one cycle every 4 degrees. The relation between the pixel value and the angle, θ , measured counter-clockwise from the X-axis is expressed as:

$$\text{Tone value (\%)} = 50 + 50 \sin[(90 \cdot \theta)^\circ]$$

The synthetic images S2 and S2A are binary representations of S1 and S1A created by causing all values of 50% or less to be recorded as 0% and all values above 50% to be recorded as 100%. S3 and S3A are similar binary images with the values less than 50% recorded as 100% and those greater than 50% as 0% (the reverse of S2 and S2A). S4 (S4A) and S5 (S5A) are created in a similar fashion as S2 (S2A) and S3 (S3A) except the dot values used are 80% and 40% rather than 100% and 0%.

Figures 2 and 3 show the construction of the resolution charts. The alternate set of these resolution charts is distinguished from primary by the white line in the upper right corner. The line is approximately 1.5 mm in width and is at an angle of 45 degrees with respect to the image.

5.2.3 Synthetic images - colour charts

Synthetic images S6 and S6A are 2 512 pixels by 3 048 pixels and 1 884 pixels by 2 286 pixels, respectively and contain 8 strips, each of which is a continuous vignette and is 256 pixels by 3 032 pixels and 192 pixels by 2 274 pixels, respectively. The vignettes range from 0% to 100% dot area for each of the four separation colours and the two- and three-colour combinations of cyan, magenta and yellow. These features are shown in figures 4 and 5. S6 and S6A also contain the text "ISO 400" and "ISO 300" around the centre of the white area between K and R.

Synthetic images S7 to S10 (and S7A to S10A) together provide the image elements defined in ISO 12642. The grouping of these elements has been chosen to allow them to be arranged so that the full data set can be reproduced on an A4 or 8½ in by 11 in sheet with a patch dimension of 6 mm or as individual groups at a patch dimension of 10 mm. The default layout of ISO 12642 demonstrates such a layout.

The patch identification number and dot percentage values shall be as defined in ISO 12642. The layout of each patch group is shown in figures 6 to 11. The combinations of dot percentage for each colour patch are the same for the primary and alternate images.

The physical arrangement of all patches in each set is the same to allow the patches to be on common centres which facilitates automated colorimetric or densitometric reading equipment. All patches in the primary set are 160 pixels square and separated from the adjacent patch by 16 pixels. Those in the alternate set are 120 pixels square and separated by 12 pixels. In addition there is a border of 8 pixels (6 in the alternate set) on the outside of each group. Thus when groups are butted to each other the 16 pixel (or 12 pixel) spacing is preserved. Each patch, when output at the stated resolution, will be 10 mm square.

The physical arrangements of the patch groups are as follows: S7 consists of 6 rows of 13 patches; S8 consists of 8 rows of 13 patches and together they represent the basic data set as defined in ISO 12642. They are 2 288 pixels by 1 056 pixels and 2 288 pixels by 1 408 pixels, respectively. S7A and S8A are identical to S7 and S8, except that they are 1 716 pixels by 792 pixels and 1 716 pixels by 1 056 pixels, respectively. S9 (S9A) contains 12 blocks of 36 patches and is 3 168 pixels by 4 224 pixels (2 376 by 3 168). S10 (S10A) contains 14 blocks, 10 with 25 patches and 4 with 16 patches. The outside dimensions are 2 464 by 4 400 pixels (1 848 by 3 300) and include a non-image area as described above.

6 Electronic data

6.1 CD-ROM data contents

The CD-ROM, included in annex A, contains 36 image data files. File names correspond to the image names as

described in clause 5.2. Table 2 shows the file name, size and descriptive name of each data file as well as the pixel height and width of each image. The file size shown represents the file as recorded and includes headers, etc. The check-sums given in annex B may be used to check the data integrity.

6.2 CD-ROM operating system compatibility

The standards used for each format layer on the SCID CD-ROM are as follows:

Physical format layer - ISO/IEC 10149
Volume and file format layer - ISO 9660
Application format layer - ISO 12639
(TIFF/IT-CT and TIFF/IT-CT/P1)

The TIFF/IT-CT conformity level applies to the primary set of SCID images and TIFF/IT-CT/P1 conformity level applies to the alternate set of SCID images. Annex C shows the TIFF/IT-CT and TIFF/IT-CT/P1 file headers of images: N1.TIF and N1A.TIF

NOTE 6 The primary set of SCID images is in conformance with TIFF/IT-CT/P1 in all respects except for DotRangeField.

NOTE 7 The format of these files is compatible with TIFF Revision 6, Section 16, and can be imported and manipulated as necessary by a wide variety of commonly used imaging software packages on platforms in general use in the industry.