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Graphic technology — Prepress digital data exchange —

Part 4: Wide gamut display-referred standard colour image data [Adobe RGB (1998)/SCID]

Technologie graphique — Échange de données numériques de préimpression —

Partie 4: Données d'image standard montrées en référence par gamme large de couleur [Adobe RGB (1998)/SCID]

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 12640-4 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

ISO 12640 consists of the following parts, under the general title *Graphic technology — Prepress digital data exchange*:

— *Part 1: CMYK standard colour image data (CMYK/SCID)*

— *Part 2: XYZ/sRGB encoded standard colour image data (XYZ/SCID)*

— *Part 3: CIELAB standard colour image data (CIELAB/SCID)*

— *Part 4: Wide gamut display-referred standard colour image data [Adobe RGB (1998)/SCID]*

— *Part 5: Scene-referred standard colour image data (RIMM/SCID)*

Introduction

0.1 Need for standard digital test images

Standard test images provide a set of data that can be used for any of the following tasks:

- evaluating the colour reproduction of imaging systems;
- evaluating colour image output devices;
- evaluating the effect of image processing algorithms applied to the images;
- evaluating the coding technologies necessary for the storage and transmission of high-definition image data, etc.

Because they exist as standard, well-defined image data sets, typical of the high quality image content commonly encountered, standard test images enable users to be confident that the images will produce good quality reproductions, if properly rendered, and that they provide a reasonable test of the evaluation task being undertaken. No limited set of images can fully test any system but the sets provided give as reasonable a test as can be expected from a limited image set. Furthermore, the existence of a standard set enables users in different locations to produce comparisons without the need to exchange images prior to reproduction.

However, different applications require that the standard image data be provided in different image states using different image encodings (see ISO 22028-1). The user needs to select those appropriate to the evaluation task being undertaken. Whilst transformation of the image data to another image state is always possible, there is, in general, no agreement amongst experts as to how this is best done. Thus, it has been considered preferable to provide data in different image states in the various parts of ISO 12640.

ISO 12640-1 provides a set of 8-bits-per-channel data that is defined in terms of CMYK dot percentages. The colours resulting from reproduction of CMYK data are strictly defined only at the time of printing, and as such the data are only applicable to evaluation of CMYK printing applications. Transformations to other image states and colour encodings might not be well defined. In fact, the data might not even be useful for CMYK printing processes different from those typically found in traditional graphic arts applications, as the image data are defined to produce “pleasing” images when reproduced on systems using “typical” inks and producing “typical” tone value rendering. Printing systems that use inks of a distinctly different colour, or produce a very different tone value rendering, will not reproduce them as pleasing images without a well-defined colour transformation. Moreover, with a bit depth of only 8 bits per channel any colour transformation employed might well introduce artefacts.

ISO 12640-2 provides a set of test image data encoded both as XYZ values with each channel scaled to the range 0 to 65 535, and as sRGB (defined in IEC 61966-2-1), with a bit depth of 8 bits per channel. (The higher bit depth for the XYZ encoding is necessary because of the perceptual non-uniformity of the linear colour space.) Both sets of data are optimized for viewing on a reference sRGB CRT display in the reference sRGB viewing environment, and relative to CIE standard illuminant D65 for which the XYZ tristimulus values were computed prior to scaling. The images are mainly designed to be used on systems utilizing sRGB as the reference encoding, and as such are mainly applicable to the consumer market and those systems for which the colour monitor is the “hub” device. Although such systems are used for some applications in the graphic arts industry, sRGB is by no means the most common image encoding. Furthermore, a particular drawback is the fact that the sRGB colour gamut is quite different in shape to the colour gamut of typical offset printing. This difference can necessitate fairly aggressive colour re-rendering to produce optimal prints from sRGB image data.

ISO 12640-3 provides a set of test image data with a large reflection medium colour gamut, illuminated using illuminant D50. The bit depth of the natural images is 16 bits per channel, while the colour charts and vignettes are 8 bits per channel. In order to be useful for applications where large, print-referred output gamuts are encountered, common in graphic technology and photography, it was felt that it would be desirable to produce an image set in which some colours are permitted to be encoded close to the boundary

of the full colour gamut attained with surface colours. Furthermore, from the perspective of colour management, it is advantageous if the images are referenced to illuminant D50, which is the predominant reference illuminant used in graphic arts and photography, for both viewing and measurement. For this reason, it has also become the predominant reference illuminant for most colour management applications.

This part of ISO 12640 provides a set of wide gamut test image data encoded as Adobe RGB with a bit depth of 16 bits per channel. These data are optimized for viewing on a reference Adobe RGB display in the reference Adobe RGB viewing environment [defined in the *Adobe RGB (1998) Color Image Encoding specification*]. The preferred rendering of these images to any media, other than the reference Adobe RGB display in the reference Adobe RGB viewing environment, is dependent on the media and viewing environment used. Therefore, no colorimetry associated with reproduction on any other media is provided.

The images are mainly designed to be used on systems utilizing Adobe RGB as the reference encoding, and as such are mainly applicable to the professional market and those systems for which the wide gamut colour monitor is the “hub” device. Such workflows are popular among professional photographers, and are increasingly used in the graphic arts. The Adobe RGB reference display colour gamut is closer to typical offset printing gamuts than the sRGB reference display colour gamut. Adobe RGB encoded images generally require much less aggressive colour re-rendering going to print than sRGB encoded images, although this difference can necessitate colour re-rendering between Adobe RGB images and sRGB images. The purpose of this part of ISO 12640 is therefore to provide a test image data set with a larger colour gamut than sRGB, related to the Adobe RGB wide gamut display-referred colour space. The bit depth of the natural images and synthetic images is 16 bits per channel.

The possible wide gamut colour encoding choices considered were Adobe RGB, opRGB (IEC 61966-2-5) and ROMM RGB (ISO 22028-2). For this part of ISO 12640 we want the images well-colour-rendered to a well-defined large gamut reference display. For this reason, Adobe RGB was preferred over the other two choices. With opRGB the completeness of the colour rendering is left more ambiguous, i.e. it is not as clearly output-referred, and the reference medium and viewing conditions are also slightly different. ROMM RGB (ISO 22028-2) is clearly output-referred, but the reference medium is a virtual reflection print (the ICC perceptual reference medium).

0.2 Characteristics of the test images

The performance of any colour reproduction system will normally be evaluated both subjectively (by viewing the final output image) and objectively (by measurement of control elements). This requirement dictates that the test images include both natural scenes (pictures) and synthetic images (colour charts and colour vignettes). Because the results of subjective image evaluation are strongly affected by the image content, it was important to ensure that the natural images were of high quality and contained diverse subject matter. However, by requiring the images to look natural, it is difficult within a single, relatively small, sample set to produce elements in the scene that contain the subtle colour differences required in such test images, that cover the full reference colour gamut defined. Thus, while most images contain colours that extend to the gamut boundary this is often only for a limited range of hues in each image. The full reference colour gamut can only be explored by utilizing the synthetic colour chart.

A survey was conducted of all TC 130 member countries to identify desirable image content and to solicit submission of suitable images for consideration. The image set that resulted consists of 14 natural images, a colour chart and a series of colour vignettes. The natural images include flesh tones, images with detail in the extreme highlights or shadows, neutral colours, brown and wood tone colours which are often difficult to reproduce, memory colours, complicated geometric shapes, fine detail, and highlight and shadow vignettes. The colour chart and colour vignette show the colour gamut of this wide gamut display-referred colour space.

0.3 File format of the digital test images

All of the images consist of pixel interleaved data (R then G then B) with the data origin at the upper left of the image, as viewed naturally, and organized by rows. These data are included as individual files within this part of ISO 12640. The image file format is as specified in ISO 12639:2004 (TIFF/IT). The images can be imported and manipulated as necessary by a wide variety of imaging software tools and platforms in general use in the industry. See Annex C for details of the TIFF header.

Graphic technology — Prepress digital data exchange —

Part 4:
Wide gamut display-referred standard colour image data [Adobe RGB (1998)/SCID]

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This part of ISO 12640 specifies a set of standard wide gamut display-referred colour images [encoded as 16-bit Adobe RGB (1998) digital data] that can be used for the evaluation of changes in image quality during coding, image processing (including colour re-rendering and colour space transformations, compression and decompression), displaying on a colour monitor and printing. These images can be used for research, testing and assessing of output systems such as printers, colour management systems and colour profiles.

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 12639:2004, *Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)*

Adobe RGB (1998) Color Image Encoding, Version 2005-05, May 2005. Available at: <http://www.adobe.com/digitalimag/pdfs/AdobeRGB1998.pdf>

3 Terms and definitions

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

3.1
Adobe RGB
three-component colour image encoding defined in *Adobe RGB (1998) Color Image Encoding*

3.2
colour gamut
solid in a colour space, consisting of all those colours that are present in a specific scene, artwork, photograph, photomechanical or other reproduction; or are capable of being created using a particular output device or medium

[ISO 12231]

3.3
colour sequence
order in which the colours are stored in an image data file

3.4
orientation
origin and direction of the first line of data, with respect to the image content as viewed by the end user

NOTE The codes used to specify orientation are listed in ISO 12639:2004.

3.5
pixel
smallest discrete picture element in a digital image file

3.6
pixel interleaved
colour data organized such that the RGB colour space values for one pixel are followed by the same sequence of colour values for the next pixel

NOTE The specific order of colour components is determined by the ColourSequence tag as defined in ISO 12639:2004. Other forms of colour data interleaving are line and plane.

4 Requirements

This part of ISO 12640 provides a set of images contained in 16 image data files which form an integral part of this part of ISO 12640. Their file names are listed in Tables 1 and 2. The colour image data shall be encoded as defined in *Adobe RGB (1998) Color Image Encoding* (hereafter referred to as Adobe RGB) using 16 bits per channel and 48 bits per colour. The image characteristics of these data are described in Clause 5, and the electronic data structure is described in Clause 6.

The procedures and guidelines for use of the image data files are given in Annex A. The image data integrity, excluding any headers, shall be checked using the check-sum procedure outlined in Annex B. Typical TIFF/IT file headers used for image files are described in Annex C. Label text insertion is described in Annex D. The histogram and gamut plots for the image data files are shown in Annex E.

5 Data set characteristics

5.1 General

The orientation of the image data is defined in accordance with ISO 12639, where a value of “1” in TAG 274 indicates that the data are to be loaded from top left, horizontally; the 0th row represents the visual top of the image and 0th column represents the visual left-hand side. The image data are pixel interleaved in the colour sequence of R then G then B (16 bits per channel) for the natural images and synthetic images.

5.2 Data set definition

The set of standard colour image data consists of 14 natural (photographed) images and two synthetic images created digitally on a computer. The synthetic images consist of one colour chart with various patches, and one colour vignette. The natural images are identified as N1 to N14, respectively, and each of them also has a descriptive name derived from the picture content (e.g. Crayons). The synthetic images are identified as S1 and S2.

The label “ISO 12640-4 RGB” is inserted in each image. The co-ordinates of the text insertion are provided in Annex D.

NOTE The image set defined in this part of ISO 12640 is based on the Adobe RGB reference display gamut. Image sets contained in other parts of ISO 12640 are based on different reference media and can be more suitable for use in evaluations where the other reference media are more relevant.

5.3 Natural images

The characteristics and typical usage of the natural images are shown in Table 1. The descriptive names of these images are given following the identification code. Figure 1 shows reduced size reproductions of the natural images.

The 14 natural images have the following characteristics:

Resolution: 16 pixels/mm

Colour values: Adobe RGB data consisting of three 16-bit values

File format: ISO 12639:2004 (TIFF/IT)

Label on image: ISO 12640-4 RGB

Image data orientation: Load from top left, horizontally

Table 1 — Natural images

Name	Aspect, image size	Characteristics and typical usage
N1 Crayons	Horizontal, 4 096 × 3 072 pixels	Picture of crayons with high saturation colours; useful for checking edge-of-gamut reproduction
N2 Flowers	Vertical, 3 072 × 4 096 pixels	Useful for assessing tonal reproduction of highlight tones and saturated reds
N3 Yarn	Horizontal, 4 096 × 3 072 pixels	Image of yarn, wool and thread suitable for evaluating the colour gamut of devices, texture and fine detail reproduction
N4 Fishing	Vertical, 3 072 × 4 096 pixels	Fishing goods with fine detail, suitable for evaluating image sharpness and reproduction of detail
N5 Vases	Horizontal, 4 080 × 3 072 pixels	Picture of transparent and semi-transparent vases, suitable for evaluating the reproduction of smooth highlight tones
N6 Leaves	Horizontal, 4 096 × 3 072 pixels	Useful in evaluating the reproduction of subtle tonal variation in the leaves and of shadow detail in the dark brown of the trunks of the trees
N7 Borabora	Horizontal, 4 124 × 3 024 pixels	Landscape image; suitable for the evaluation of the reproduction of deep blue and green colours with subtle tonal variation
N8 Sunflower	Horizontal, 3 040 × 2 014 pixels	Field of sunflowers with memory colours for sky, trees and grass; suitable for evaluating the reproduction of natural scenes
N9 Bride	Vertical, 3 072 × 4 096 pixels	Close-up image to evaluate the reproduction of human skin tones
N10 Walkathon	Vertical, 2 000 × 3 008 pixels	Image of children in walking gear with bright balloons can be used to check the reproduction of images that include saturated colours and skin tones
N11 Spoon	Horizontal, 4 096 × 3 072 pixels	Image of silverware to evaluate the reproduction characteristics of highlight tones and neutral colours
N12 Violin	Vertical, 3 072 × 4 096 pixels	Low-key image of a room scene containing miscellaneous objects to evaluate dark colours, particularly browns
N13 Glass	Horizontal, 4 096 × 3 072 pixels	Image of glassware to evaluate the reproduction characteristics of highlight tones, shadow tones and neutral colours
N14 Beach	Horizontal, 3 040 × 2 014 pixels	Image of a sunny beach shot from shade of trees can be used to evaluate the reproduction of images having a high dynamic range

N1 Crayons

N2 Flowers

N3 Yarns

N4 Fishing

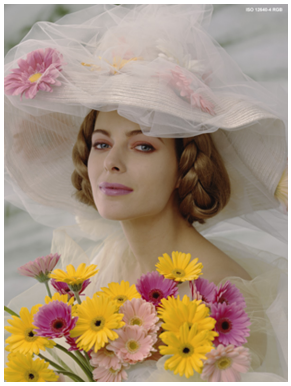
N5 Vases

N6 Leaves

N7 Borabora

N8 Sunflower

Figure 1 (*continued*)



N9 Bride

N10 Walkathon

N11 Spoon

N12 Violin

N13 Glass

N14 Beach

Figure 1 — Reduced size reproductions of the natural images

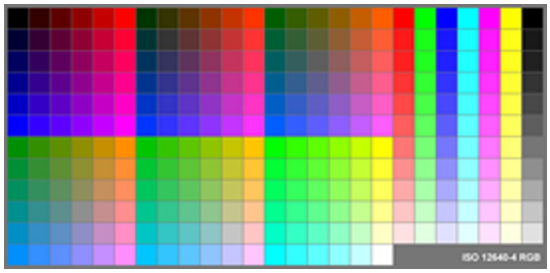
5.4 Synthetic images

5.4.1 Synthetic image content

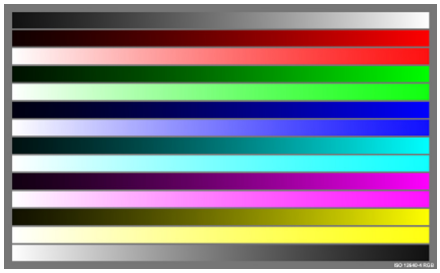
The synthetic images consist of a colour chart and a series of colour vignettes. Figure 2 shows reduced-size reproductions of the synthetic images. The interleaving, colour sequence, colour values and orientation are the same as for the natural images. The image sizes are shown in Table 2.

Table 2 — Synthetic images

Name		Aspect	Height pixels	Width pixels
S1	Colour chart	Landscape	1 332	2 736
S2	Colour vignettes	Landscape	2 608	4 256



S1 Colour chart



S2 Colour vignettes

Figure 2 — Reduced-size reproductions of the synthetic images

5.4.2 Colour chart

5.4.2.1 Design of colour chart

Image S1 (shown schematically in Figure 3) is a colour chart that consists of colour patches that are all specified to be within the Adobe RGB reference display colour gamut. By using these patches, the fidelity of colour reproduction of an image output device to the colorimetry of the original image file may be evaluated objectively by measurement. Image S1 is encoded in 16-bit Adobe RGB. Each part of the chart has two sections:

— section containing 6^3 (i.e. 216) tertiary colour patches;

— primary, secondary and tertiary grey colour section (77 patches in total).

The Adobe RGB image data encoded can be converted to viewer-observed image colorimetry using the transforms specified in *Adobe RGB*. The complete transformation, through the normalized tristimulus values to the viewer-observed tristimulus values, should be used.

NOTE When comparing the fidelity of a colour reproduction to that of an original, it is generally most appropriate to compare viewer-observed colorimetric values. However, the fidelity of measured reproduction colorimetry to original image colorimetry is not generally considered as indicative of the quality of the reproduction. To produce optimal quality, it is frequently necessary to adjust the colorimetry of a reproduction to be different from that directly associated with the image data in order to account for any differences between the Adobe RGB viewing conditions and the reproduction viewing conditions, and because of differences between the Adobe RGB and reproduction medium colour gamuts.