
**Graphic technology — Prepress digital
data exchange —**

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

*Technologie graphique — Échange de données numériques de
préimpression —*

*Partie 5: Données d'image standard en couleurs montrées en
référence par scène (RIMM/SCID)*



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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 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 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 colour image data

Standard colour image data 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.

These standard, well-defined image data sets, are typical of the high quality image content commonly encountered when capturing and printing images. Users can therefore be confident that the images should 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.

Different applications require that the standard image data be provided in different image states using different image encodings (see ISO 22028-1), so the user needs to select those appropriate to the evaluation task being undertaken. While transformation of the image data to another image state is always possible, there is, in general, no agreement amongst experts as to how this should be done. Thus, it has been considered preferable to provide data in different image states in the various parts of ISO 12640. The relationship between image states is shown in [Figure 1](#) along with the applicable parts of ISO 12640.

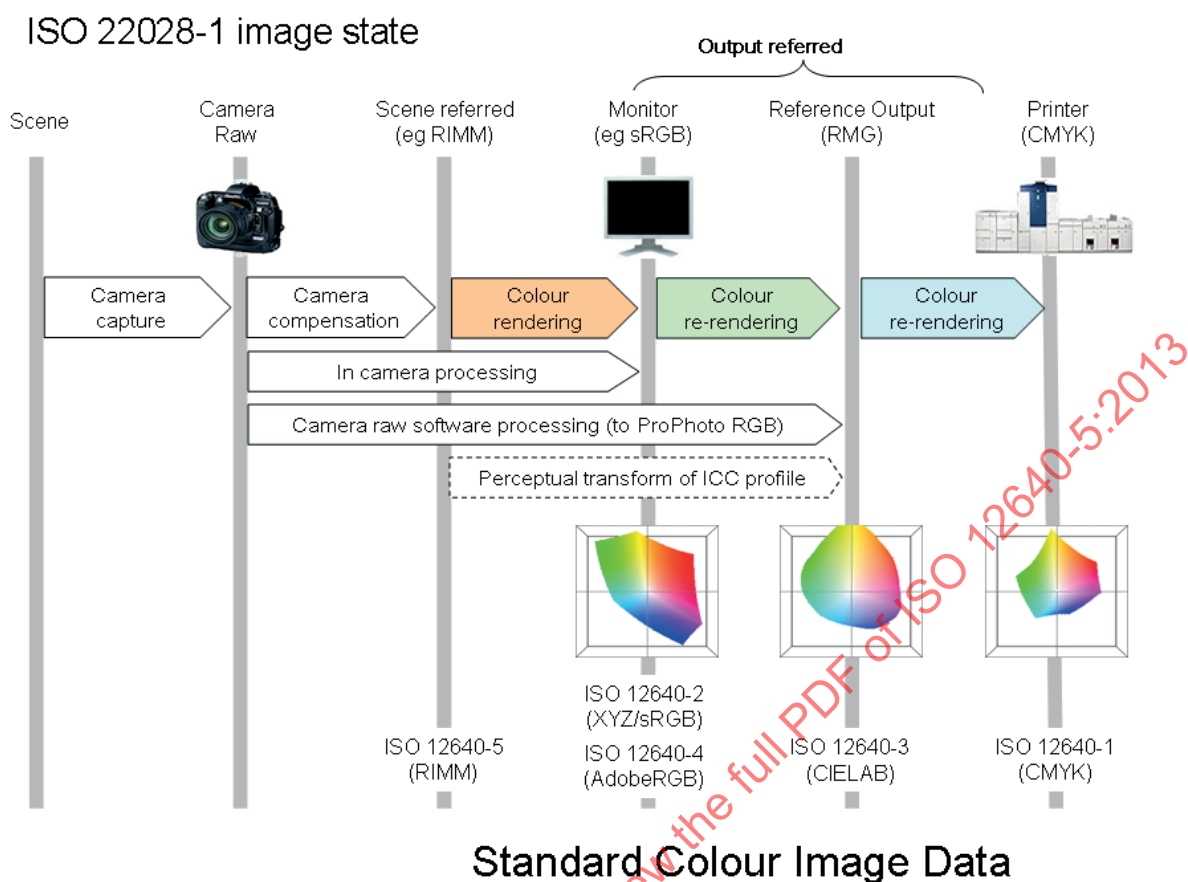


Figure 1 — Relationship between image states

ISO 12640-1 provides a set of 8 bits/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/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 0-65535, and as sRGB (defined in IEC 61966-2-1), with a bit depth of 8 bits/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 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 primarily applicable to systems for which a colour monitor similar to the sRGB reference display is the “hub” device. Although such systems are used for consumer photography, they are less popular in the graphic arts industry because the sRGB colour gamut is quite different in shape from 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/channel, while the colour charts and

vignettes are 8 bits/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, both for viewing and measurement. For this reason, it has also become the predominant reference illuminant for most colour management applications.

ISO 12640-4 provides a set of wide-gamut test image data encoded as Adobe RGB with a bit depth of 16 bits/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) Colour Image Encoding specification). The images are designed to be used mainly 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 ISO 12640-4 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/channel.

The possible wide gamut colour encoding choices considered were Adobe RGB, opRGB (IEC 61966-2-5) and ROMM RGB (ISO 22028-2). For ISO 12640-4, it was important that the images were well-colour-rendered to a well-defined large gamut reference display, for which 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), so the image state is identical to that for ISO 12640-3.

This part of ISO 12640 provides a set of scene-referred test image data encoded as RIMM RGB with a bit depth of 16 bits/channel. These data are estimates of scene colorimetry obtained by capturing natural scenes using a variety of digital cameras and transforming the captured raw camera RGB signals to scene colorimetry estimates. The accuracy of these estimates is influenced by a number of factors including the degree to which the camera spectral sensitivities approximate human visual system colour matching functions, the appropriateness of the transformation from raw camera RGB signals to colorimetry estimates, optical effects such as off-axis decrease in signal, aberrations and flare, and the noise present in the camera signals. The transformations applied to obtain the colorimetry estimates were general transformations, i.e. they were not optimized for the spectral characteristics of each scene. Consequently, there can in some cases be significant errors in the estimates. The image state of these data is scene-referred because no attempt has been made to colour render the data to produce a pleasing reproduction on some output medium. The only processing applied to these data based on visual evaluation was to select the scene adopted white. This was accomplished by applying gains individually to the camera channels to achieve the desired white balance, converting to scene-referred, and then adjusting the overall gain in a linear, scene-referred working space while viewing the image with the example colour rendering transform specified in ISO/TS 22028-3:2012, Annex A, applied. Different white balances can be desired in some cases for aesthetic reasons, and different overall gains can be needed if different colour rendering transforms are used. The images provided in this part of ISO 12640 are mainly applicable for evaluating colour rendering to different output media.

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, it is difficult within a single, relatively small, sample set to produce elements in the scene that contain all the subtle colour differences required in test images, and that span the full range of colours that can be encountered in real scenes. For this reason, synthetic colour charts are also included. These colour charts are limited by the integer RIMM RGB encoding and by the spectral locus (for areas where the RIMM RGB encoding extends outside the spectral locus). In the future, it is proposed to develop a second set of floating point RIMM/SCID which are not limited by the integer RIMM RGB encoding.

To obtain the images, 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 44 natural images, two colour charts and a series of colour vignettes. The natural images include flesh tones, hair, foliage, water, sky, flowers and other memory colours in scenes with a variety of dynamic ranges.

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 (TIFF/IT). A RIMM RGB ICC profile meeting the requirements of ISO 15076-1 is embedded in each image file.

The images can be imported and manipulated as necessary by a wide variety of commonly used imaging software tools and platforms in general use in the industry. (See [Annex C](#) for details of the TIFF header and the RIMM RGB ICC profile.)

Graphic technology — Prepress digital data exchange —

Part 5:

Scene-referred standard colour image data (RIMM/SCID)

1 Scope

This part of ISO 12640 specifies a set of standard scene-referred colour images (encoded as 16-bit RIMM RGB digital data) that can be used to evaluate transforms from a scene-referred image state to an output-referred image state (colour rendering transforms). They can be used for research, testing and assessing colour rendering transforms, in systems such as digital cameras, camera raw processing applications, colour management systems, colour profiles, and output devices such as displays and printers.

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

ISO/TS 22028-3:2012, *Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 3: Reference input medium metric RGB colour image encoding (RIMM RGB)*

3 Terms and definitions

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

3.1

additive RGB colour space

colorimetric colour space having three colour primaries (generally red, green and blue) such that CIE XYZ tristimulus values can be determined from the RGB colour space values by forming a weighted combination of the CIE XYZ tristimulus values for the individual colour primaries, where the weights are proportional to the radiometrically linear colour space values for the corresponding colour primaries

Note 1 to entry: A simple linear 3×3 transformation can be used to transform between CIE XYZ tristimulus values and the radiometrically linear colour space values for an additive RGB colour space.

Note 2 to entry: Additive RGB colour spaces are defined by specifying the CIE chromaticity values for a set of additive RGB primaries and a colour space white point, together with a colour component transfer function.

[SOURCE: ISO 22028-1:2004, 3.3]

3.2

adopted white

spectral radiance distribution as seen by an image capture or measurement device and converted to colour signals that are considered to be perfectly achromatic and to have an observer adaptive luminance factor of unity; i.e. colour signals that are considered to correspond to a perfect white diffuser

Note 1 to entry: The adopted white may vary within a scene.

Note 2 to entry: No assumptions should be made concerning the relation between the adapted or adopted white and measurements of near perfectly reflecting diffusers in a scene, because measurements of such diffusers will depend on the illumination and viewing geometry, and other elements in the scene that may affect perception. It is easy to arrange conditions for which a near perfectly reflecting diffuser will appear to be grey or coloured.

[SOURCE: ISO 22028-1:2004, 3.4]

3.3 colour component transfer function CCTF

single variable, monotonic mathematical function applied individually to one or more colour channels of a colour space

Note 1 to entry: Colour component transfer functions are frequently used to account for the nonlinear response of a reference device and/or to improve the visual uniformity of a colour space.

Note 2 to entry: Generally, colour component transfer functions will be nonlinear functions such as a power-law (i.e. “gamma”) function or a logarithmic function. However, in some cases a linear colour component transfer function may be used.

[SOURCE: ISO 22028-1:2004, 3.6, modified — Abbreviated term has been added]

3.4 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 capable of being created using a particular output device and/or medium

[SOURCE: ISO 22028-1:2004, 3.8]

3.5 colour rendering

mapping of image data representing the colour-space coordinates of the elements of a scene to output-referred image data representing the colour-space coordinates of the elements of a reproduction

Note 1 to entry: Colour rendering generally consists of one or more of the following: compensating for differences in the input and output viewing conditions, tone scale and gamut mapping to map the scene colours onto the dynamic range and colour gamut of the reproduction, and applying preference adjustments.

[SOURCE: ISO 22028-1:2004, 3.11]

3.6 colour sequence

order in which the colours are stored in an image data file

3.7 orientation

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

Note 1 to entry: The codes used to specify orientation are contained in ISO 12639.

3.8 output-referred image state

image state associated with image data that represents the colour-space coordinates of the elements of an image that has undergone colour rendering appropriate for a specified real or virtual output device and viewing conditions

Note 1 to entry: When the phrase “output-referred” is used as a qualifier to an object, it implies that the object is in an output-referred image state. For example, output-referred image data are image data in an output-referred image state.

Note 2 to entry: Output-referred image data are referred to the specified output device and viewing conditions. A single scene can be colour-rendered to a variety of output-referred representations depending on the anticipated output viewing conditions, media limitations, and/or artistic intents.

Note 3 to entry: Output-referred image data may become the starting point for a subsequent reproduction process. For example, sRGB output-referred image data are frequently considered to be the starting point for the colour re-rendering performed by a printer designed to receive sRGB image data.

[SOURCE: ISO 22028-1:2004, 3.33]

3.9

pixel

smallest discrete picture element in a digital image file

3.10

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

3.11

scene

spectral radiances of a view of the natural world as measured from a specified vantage point in space and at a specified time

Note 1 to entry: A scene may correspond to an actual view of the natural world or to a computer-generated virtual scene simulating such a view.

[SOURCE: ISO 22028-1:2004, 3.35]

3.12

scene-referred image state

image state associated with image data that represents estimates of the colour-space coordinates of the elements of a scene

Note 1 to entry: When the phrase “scene-referred” is used as a qualifier to an object, it implies that the object is in a scene-referred image state. For example, scene-referred image data are image data in a scene-referred image state.

Note 2 to entry: Scene-referred image data can be determined from raw digital still camera (DSC) image data before colour rendering is performed. Generally, DSCs do not write scene-referred image data in image files, but some may do so in a special mode intended for this purpose. Typically, DSCs write standard output-referred image data where colour rendering has already been performed.

Note 3 to entry: Scene-referred image data typically represent relative scene colorimetry estimates. Absolute scene colorimetry estimates may be calculated using a scaling factor. The scaling factor can be derived from additional information such as the image OECF, Fnumber or ApertureValue, and ExposureTime or ShutterSpeedValue tags.

Note 4 to entry: Scene-referred image data may contain inaccuracies due to the dynamic range limitations of the capture device, noise from various sources, quantization, optical blurring and flare that are not corrected for, and colour analysis errors due to capture device metamerism. In some cases, these sources of inaccuracy can be significant.

Note 5 to entry: The transformation from raw DSC image to scene-referred image data depends on the relative adopted whites selected for the scene and the colour space used to encode the image data. If the chosen scene adopted white is inappropriate, additional errors will be introduced into the scene-referred image data. These errors may be correctable if the transform used to produce the scene-referred image data is known, and the colour encoding used for the incorrect scene-referred image data has adequate precision and dynamic range.

Note 6 to entry: The scene may correspond to an actual view of the natural world, or may be a computer-generated virtual scene simulating such a view. It may also correspond to a modified scene determined by applying modifications to an original scene to produce a different desired scene. Any such modifications should leave the image in a scene-referred image state, and should be done in the context of an expected colour rendering transform.

[SOURCE: ISO 22028-1:2004, 3.36]

4 Data description

4.1 General

This part of ISO 12640 consists of 47 image data files and specifications of the content of these files and their use as provided in this part of ISO 12640. The image file names are listed in [Table 1](#), [Table 2](#) and [Table 3](#). The colour image data are encoded in RIMM RGB as specified in ISO/TS 22028-3, using 16 bits/channel and 48 bits/pixel. The image characteristics of these data are described in [4.5](#) and [4.6](#), and the electronic data structure in [Clause 5](#).

4.2 Data set definition

The set of standard colour image data consists of 44 natural images, captured using digital still cameras, and three synthetic images. The primary set of natural images are identified as NP01 to NP27 and the secondary set as NS01 to NS17, respectively. Each of them also has a descriptive name derived from the picture content (e.g. “Falls”). The synthetic images are identified as S1, S2 and S3.

The label “ISO 12640-5 RIMM” is inserted in each image. The coordinates of the text insertion are provided in [Annex D](#).

4.3 Image data arrangement

The image data are pixel interleaved in the colour sequence of R then G then B (16 bits/channel) for the images. The image data orientation corresponds to a value of 1 in TAG 274 of ISO 12639 (load from top left, horizontally; the 0th row represents the visual top of the image and the 0th column represents the visual left-hand side).

4.4 Data colour encoding

The image data are encoded as RIMM RGB as specified in ISO/TS 22028-3.

The Reference Input Medium Metric RGB (RIMM RGB) encoding is an extended-colour-gamut RGB colour image encoding of the colorimetry of a scene-referred image. The colorimetry is encoded using an additive RGB colour space associated with a hypothetical additive colour device having a specified set of primaries, no cross-talk between the colour channels and a maximum luminance value corresponding to 200 % of the luminance of the adopted white (i.e. a maximum luminance factor of 2,0).

There are three different precision levels specified for RIMM RGB. The images in this part of ISO 12640 are encoded as RIMM16 RGB for 16 bits/channel (48 bits/pixel) representations.

The scene-referred colorimetry has been adapted to the RIMM RGB encoding white, which has the chromaticity of CIE Standard Illuminant D₅₀ ($x_0 = 0,345\ 7$, $y_0 = 0,358\ 5$). This colorimetry was obtained as follows.

- a) Demosaic the digital camera raw image data where necessary and linearize with respect to scene radiance, including black frame and estimated flare subtraction.
- b) Determine the linear camera raw channel values R_W , G_W and B_W that correspond to the scene adopted white.

- c) Multiply the linear camera raw image data channels R , G and B by $1/R_W$, $1/G_W$ and $1/B_W$, respectively, so that values $\{1, 1, 1\}$ are obtained for the scene adopted white. This results in white-balanced linear camera raw image data.
- d) Determine a scene analysis matrix that converts the white-balanced linear camera raw image data to linear RIMM RGB image data, where the linear RIMM RGB image data represents estimates of the scene colorimetry after chromatic adaptation to D50. The matrices determined are typically camera and scene adopted white specific, and depend on the scene spectral radiance characteristics assumed. Technical information on how to determine scene analysis matrices is provided in ISO/TR 17321-2.
- e) Apply the scene analysis matrix to the white-balanced linear camera raw image data to produce linear RIMM RGB image data.
- f) Apply the RIMM16 RGB CCTF as specified in ISO/TS 22028-3.

A RIMM RGB ICC profile is embedded in each image file to facilitate use in colour managed systems, and to provide an example colour rendering for the images using the perceptual rendering intent. The example colour rendering specified in ISO/TS 22028-3:2012, Annex A, is used in the perceptual transform.

The above steps do not include any compensation for the colour appearance resulting from different scene illumination levels. Instead, the brightness value for each scene is recorded in [Table 2](#). The brightness values (BV) are determined from the camera aperture, shutter speed and exposure index recorded in the raw image file metadata as shown in Formula (1).

$$BV = AV + TV - SV \quad (1)$$

where

$AV = \text{LOG}_2[A^2]$, where A is the effective f-number of the camera lens;

$TV = \text{LOG}_2(1/t)$, where t is the photosite integration (exposure) time in seconds;

$SV = \text{LOG}_2(EI/3)$, where EI is the exposure index that would have been used if the camera exposure compensation were zero.

For example, if the exposure index is set on ISO 100 and the exposure compensation is set on minus one stop, the effective exposure index is 200 and $SV = \text{LOG}_2(200/3) = 6$.

The estimated midtone (18 % reflectance) scene luminance level L_A is calculated from the BV value as shown in Formula (2).

$$L_A = 3,7 \times 2^{BV} \quad (2)$$

4.5 Natural images

4.5.1 Description

The characteristics of the natural images (orientation, image size, brightness value (BV), average luminance factor (Y), data range and dynamic range) are shown in [Tables 1](#) and [2](#). Average Y , data range and dynamic range are calculated using the Y value of XYZ tristimulus values of an image scaled to be 1/16 of the original size (each dimension 1/16 of the original dimension) using bicubic scaling. The data range Y is the ratio of maximum Y value to the smallest Y value present in the image that is larger than zero. The dynamic range is calculated by taking the ratio of the highlight Y value to the shadow Y value, where the highlight Y value is the value corresponding to 0,999 5 on a cumulative Y histogram, and the shadow Y value is the value corresponding to 0,005 on a cumulative Y histogram. Other methods for highlight and shadow Y value estimation may also be used; the method used to calculate the dynamic range values in [Tables 1](#) and [2](#) is not intended to be considered a recommended method.

Table 1 shows a primary set and comprises 27 images. Table 2 shows a secondary set and consists of 17 images. It is strongly recommended that all of the images in the primary set be used and, where necessary, additional images from the secondary set should be used to supplement this set.

The descriptive names of these images are given following the identification code. Two renderings are shown in Figure 2: a colorimetric conversion of the scene-referred image to sRGB and a perceptual colour rendering to sRGB.

The 44 natural images shall be interpreting as having the following characteristics:

- Resolution: 24 pixels/mm;
- Colour values: RIMM RGB data consisting of three 16-bit values;
- File format: ISO 12639:2004 (TIFF/IT);
- Label on image: “ISO 12640-5”;
- Image data orientation: load from top left, horizontally.

Table 1 — Primary set of natural images

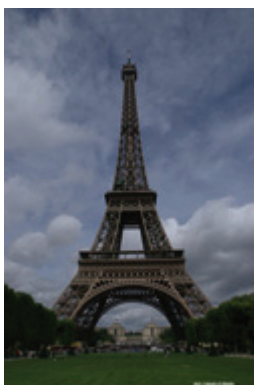
Name	Aspect, image size	BV	Average Y	Data range Y	Dynamic range Y
NP01 Falls	Vertical, 2 014 × 3 040 pixels	9	1,985	2 621	177,3
NP02 Eiffel	Vertical, 2 014 × 3 040 pixels	10	0,322 5	1 513	98,06
NP03 Mickey	Vertical, 2 036 × 3 040 pixels	5	0,264 5	10 927	248,1
NP04 Butterfly	Horizontal, 4 256 × 2 848 pixels	8	0,103 0	126,4	88,24
NP05 Threads	Horizontal, 4 272 × 2 864 pixels	6	0,091 04	29 617 232	647,4
NP06 Fruits	Horizontal, 4 272 × 2 864 pixels	6	0,306 0	344,2	173,4
NP07 Canal	Horizontal, 4 256 × 2 848 pixels	9	0,125 6	1 145	159,4
NP08 WhiteFlowers	Horizontal, 3 872 × 2 592 pixels	8	0,131 5	890,3	168,0
NP09 BarHarborPresunrise	Horizontal, 4 284 × 2 408 pixels	7	0,161 7	24 647 243	237,6
NP10 BenJerrys	Horizontal, 4 288 × 2 412 pixels	10	0,193 9	3 195	99,08
NP11 DelicateFlowers	Horizontal, 4 288 × 2 848 pixels	7	0,342 1	252,6	47,38
NP12 DevilsBathtub	Horizontal, 4 288 × 2 412 pixels	11	0,089 18	20 662	314,8
NP13 Exploratorium	Horizontal, 4 288 × 2 848 pixels	10	0,155 3	16 405	121,5
NP14 GoldenGate	Horizontal, 4 288 × 2 844 pixels	−2	0,064 94	3 019	188,2
NP15 HancockSeedField	Horizontal, 4 280 × 2 408 pixels	8	0,410 5	9 286 174	39,99
NP16 NiagaraFalls	Horizontal, 4 280 × 2 408 pixels	10	0,353 4	458,2	70,59
NP17 RedwoodSunset	Horizontal, 4 284 × 2 408 pixels	8	0,172 3	60 083 240	869,8
NP18 Route66Museum	Horizontal, 4 288 × 2 848 pixels	3	0,411 3	11 407	44,31
NP19 SouthBranchKingsRiver	Vertical, 2 844 × 4 280 pixels	9	0,106 2	64 569 951	304,5
NP20 TupperLake	Horizontal, 4 288 × 2 848 pixels	9	0,235 9	60,38	25,59
NP21 Chandelier	Horizontal, 3 888 × 2 592 pixels	4	0,091 99	5 178	800,0
NP22 Clock	Horizontal, 3 888 × 2 592 pixels	3	0,220 4	42 953	120,1
NP23 Meat	Horizontal, 3 888 × 2 592 pixels	3	0,207 1	63 245 207	220,1
NP24 Peacock	Horizontal, 3 888 × 2 592 pixels	8	0,185 1	2 280	168,5
NP25 BlueFace	Vertical, 2 592 × 3 888 pixels	6	0,184 1	30 925 553	239,84
NP26 PoundPake	Horizontal, 3 888 × 2 592 pixels	0	0,158 5	1 031	146,2
NP27 LasVegas	Horizontal, 3 888 × 2 592 pixels	−3	0,091 99	3 437	414,3

Table 2 — Secondary set of natural images

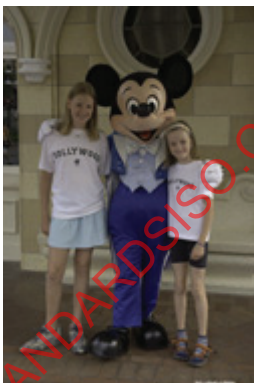
Name	Aspect, image size	BV	Average Y	Data range Y	Dynamic range Y
NS01 Maple	Horizontal, 3 040 × 2 014 pixels	7	0,156 3	161,6	45,45
NS02 River	Horizontal, 3 040 × 2 014 pixels	9	0,258 3	64 879 055	246,9
NS03 Marker	Horizontal, 4 272 × 2 864 pixels	7	0,232 5	768,7	78,85
NS04 Flowers	Horizontal, 4 272 × 2 864 pixels	5	0,216 7	193,7	92,71
NS05 Fluorescence	Horizontal, 4 272 × 2 864 pixels	7	0,478 4	222,1	85,92
NS06 Hotel	Horizontal, 3 040 × 2 036 pixels	7	1,756	414,7	182,3
NS07 Pyramid	Horizontal, 3 040 × 2 036 pixels	10	0,735 8	18,63	11,74
NS08 Nile	Horizontal, 3 040 × 2 036 pixels	9	1,237	242,4	71,72
NS09 Felucca	Horizontal, 3 040 × 2 036 pixels	10	0,810 5	115,5	44,46
NS10 CherryBlossom	Horizontal, 3 040 × 2 036 pixels	8	0,812 6	84 845	101,1
NS11 Iris	Horizontal, 3 040 × 2 036 pixels	9	1,084	8 468 419	77,28
NS12 Wharf	Horizontal, 3 040 × 2 036 2 pixels	9	1,128	683,8	174,4
NS13 Hiking	Horizontal, 3 872 × 2 592 pixels	9	0,125 6	1 145	107,0
NS14 CadesCove	Horizontal, 4 288 × 2 412 pixels	9	0,278 3	3 834	157,0
NS15 FourCornersStorm	Horizontal, 4 288 × 2 848 pixels	5	0,212 8	125,3	17,50
NS16 Sunset	Horizontal, 3 872 × 2 592 pixels	6	0,145 2	6 096 789	253,7
NS17 Headlight	Horizontal, 3 888 × 2 592 pixels	9	0,198 7	81 111	476,3



NP01 Falls

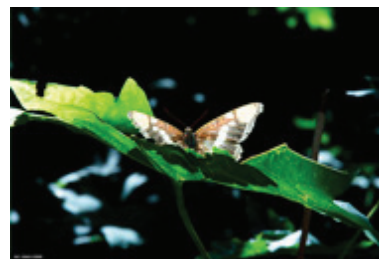


NP02 Eiffel



NP03 Mickey

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP04 Butterfly



NP05 Threads

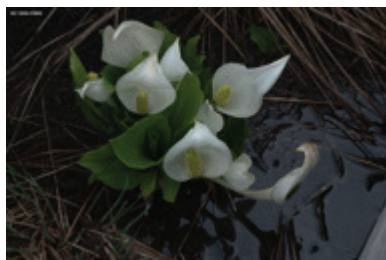


NP06 Fruits



NP07 Canal

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP08 White Flowers



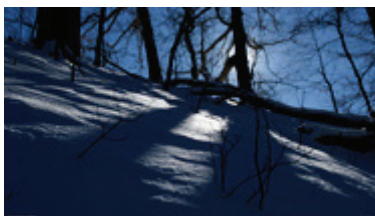
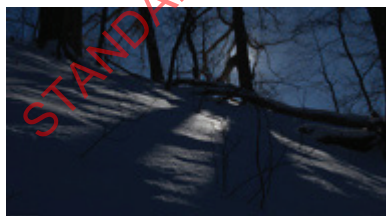
NP09 BarHarborPresunrise



NP10 Benferrys



NP11 DelicateFlowers

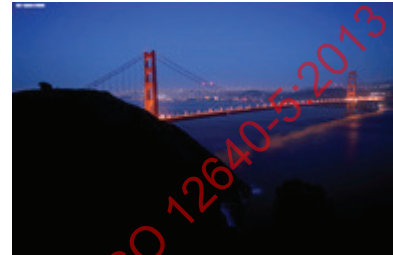


NP12 DevilsBathtub

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP13 Exploratorium



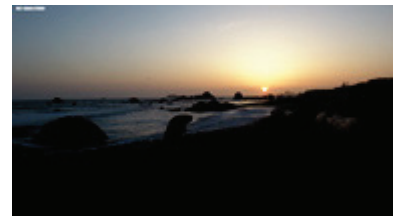
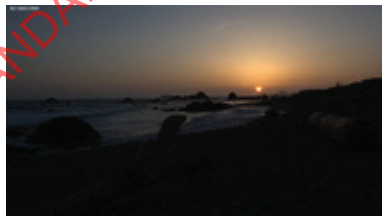
NP14 GoldenGate



NP15 HancockSeedField



NP16 NiagaraFalls

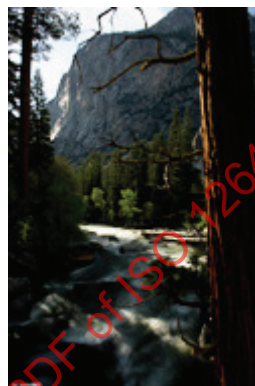


NP17 RedwoodSunset

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP18 Route66Museum



NP19 SouthBranchKingsRiver

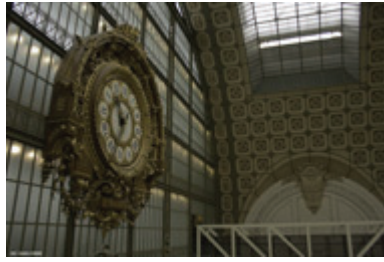


NP20 TupperLake



NP21 Chandelier

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP22 Clock



NP23 Meat



NP24 Peacock

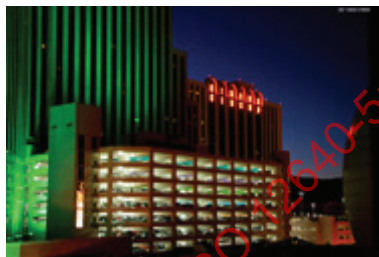
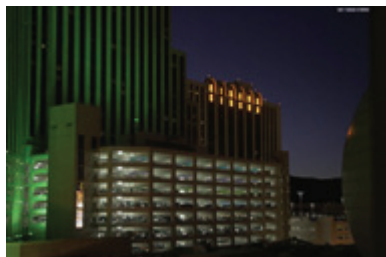


NP25 BlueFace

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NP26 PoundCake



NP27 LasVegas



NS01 Maple



NS02 River

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NS03 Marker



NS04 Flowers

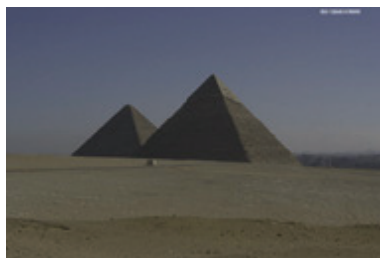


NS05 Fluorescence



NS06 Hotel

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NS07 Pyramid



NS08 Nile



NS09 Felucca



NS10 CherryBlossom

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NS11 Iris



NS12 Wharf



NS13 Hiking

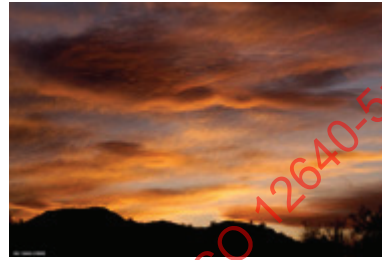
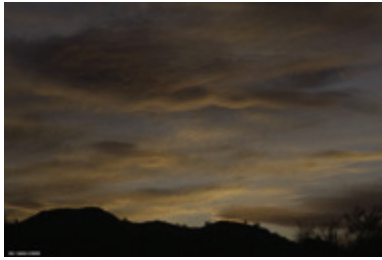


NS14 CadesCove

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images (*continued*)



NS15 FourCornersStorm



NS16 Sunset



NS17 Headlight

Figure 2 — Samples of reduced size media-relative colorimetric conversion to sRGB (left) and colour rendered sRGB (right) reproductions of scene-referred images

4.5.2 Rendering

In Figure 2, the images on the left side are scene-referred colorimetry scaled to the sRGB dynamic range and encoded as sRGB. They were produced by applying the following steps.

- Convert from (nonlinear) RIMM16 RGB to linear RIMM RGB by inverting the RIMM16 RGB CCTF specified in ISO/TS 22028-3. A RIMM16 RGB code value of 65535 will map to a linear RIMM RGB value of 2.
- Divide the linear RIMM RGB values by 2 to normalize them to the 0-1 sRGB encoding range.
- Convert from the RIMM RGB white point and primaries to the sRGB white point and primaries as shown in Formula (3).

$$\begin{bmatrix} R_{\text{sRGBlin}} \\ G_{\text{sRGBlin}} \\ B_{\text{sRGBlin}} \end{bmatrix} = \begin{bmatrix} 2,03426 & -0,72738 & -0,30688 \\ -0,22873 & 1,23161 & -0,00288 \\ -0,00850 & -0,15331 & 1,16181 \end{bmatrix} \begin{bmatrix} R_{\text{RIMMlin}} \\ G_{\text{RIMMlin}} \\ B_{\text{RIMMlin}} \end{bmatrix} \quad (3)$$

NOTE 1 The matrix in Formula (3) was obtained by multiplying the linear Bradford adapted D50 XYZ to sRGB matrix with the inverse RIMM conversion matrix from ISO/TS 22028-3.

- d) Clip the normalized linear sRGB values to the 0-1 sRGB encoding range in each channel to limit the colour gamut to that of the sRGB reference display.
- e) Apply the 8-bit sRGB CCTF as specified in IEC 61966-2-1.

NOTE 2 The scene-referred conversion can be accomplished using the ISO/TS 22028-3_RIMM-RGB-exCR.icc profile as the source profile, the sRGB_v4_ICC_preference.icc profile as the destination profile, and the media-relative colorimetric rendering intent with black point compensation on.

NOTE 3 The output-referred conversion can be accomplished by using the ISO/TS 22028-3_RIMM-RGB-exCR.icc profile as the source profile, the sRGB_v4_ICC_preference.icc profile as the destination profile, and the perceptual rendering intent to convert to sRGB. The detailed steps of the output-referred conversion are not provided here because the perceptual rendering intent of the sRGB_v4_ICC_preference.icc profile includes a 17x17x17 lookup-table.

4.6 Synthetic images

4.6.1 Description

The synthetic images consist of two colour charts and a series of colour vignettes. The image sizes, average Y, data range and dynamic range described in 4.5 are as shown in Table 3.

Table 3 — Synthetic images

	Name	Aspect	Height (pixels)	Width (pixels)	Average Y	Data range Y	Dynamic range Y
S1	Colour chart 1	Landscape	2 116	3 922	252,0	252,0	196,6
S2	Colour chart 2	Landscape	1 252	3 274	5 616	5 616	764,1
S3	Colour vignettes	Landscape	2 608	4 256	55 397 535	55 397 535	2728

Figure 3 shows reduced size reproductions of the synthetic images as both scene-referred and colour rendered sRGB. The interleaving, colour sequence, rendering methods, colour values and orientation are the same as for the natural images.

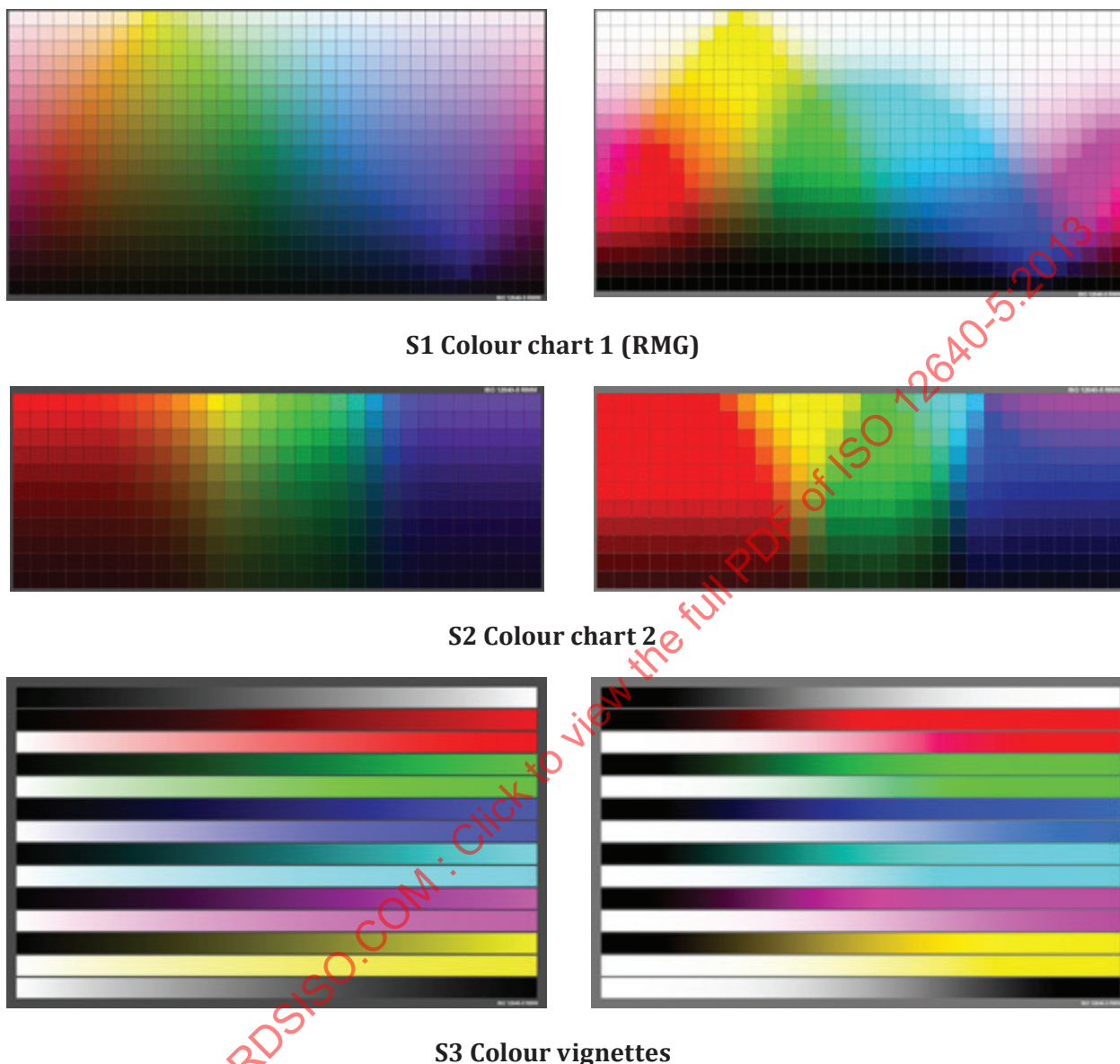


Figure 3 — Reduced size reproductions of the synthetic images

4.6.2 Colour chart 1

The synthetic image S1 is a colour chart that consists of colour patches that are all specified in ISO 12640-3:2007, Table B.4 (reference medium gamut), but with the CIELAB normalization white changed to the RIMM RGB encoding white, which is two times the scene adopted white. The patches in the top row have an L^* value of 95, the patches in the bottom row have an L^* value of 5, and intermediate rows are spaced at intervals of 5 units in L^* . Patches in the leftmost column have a CIELAB hue angle of 0 degrees and patches in the rightmost column have a CIELAB hue angle of 350 degrees. Intermediate columns are spaced at CIELAB hue angles that are multiples of 10 degrees. The surround has an L^* value of 50.

Using these patches, colour rendering transforms may be evaluated objectively using measurements. Image S1 is encoded as 16-bit RIMM RGB.

The RIMM RGB image data for image S1 was obtained by the following procedure.

- a) Convert CIELAB data of ISO 12640-3:2007, Table B.4, to XYZ using the RIMM RGB encoding white, which is two times the scene adopted white, as the CIELAB normalization white.
- b) Convert XYZ to linear-RIMM RGB. That is a primaries conversion.
- c) Encode values as 16-bit RIMM RGB.

4.6.3 Colour chart 2

The synthetic image S2 patches follow the intersection of the RIMM gamut boundary and the spectral locus, effectively defining the gamut boundary of real-world scene colours that can be encoded in RIMM RGB. Each column in the image is an exposure series of constant chromaticity at a different dominant wavelength. The column dominant wavelengths span the range from 400 nm to 690 nm in 10 nm increments. Each row represents an exposure that is one-half stop less than that of the row above, with the 11 rows covering a five-stop range from 1 stop above to 4 stops below the adopted white.

Synthetic image S2 can be used for a variety of purposes, such as:

- checking colour rendering and gamut mapping operations for handling of extreme colours and exposure invariance,
- checking image adjustment algorithms, such as brightness, contrast and saturation operators, for handling of extreme colours, and
- comparing the S2 gamut boundary to scene-referred image gamuts in gamut viewing software applications.

As the colours in this image are either on the spectral locus (dominant wavelengths 465 nm to 485 nm and 530 nm to 680 nm), or on the RIMM RGB encoding boundary (other dominant wavelengths), they are extremely saturated and cannot be reproduced accurately on general available output devices. Consequently, when viewing this image the colours displayed will almost always have undergone some gamut mapping.

4.6.4 Colour vignettes

4.6.4.1 Design

The synthetic image S3 colour vignettes are based on monochromatic RGB primaries determined by drawing lines in xy chromaticity space from the RIMM RGB white point chromaticity to each of the three RIMM RGB primaries, with the primaries being the chromaticities where the lines intersect the spectral locus. The secondaries are the midpoints of the sides of the resulting monochromatic primary triangle. Image S3 is a set of coloured vignettes in which the lightness continuously changes along the horizontal direction for each primary and secondary.

4.6.4.2 Generation of the content of the vignettes

The RIMM RGB image data for image S3 was obtained by a two-step procedure. The first step projects the RIMM primaries on to the spectral locus and the second step is to generate colour vignettes.

- a) The first step identifies the new primaries as follows.
 - 1) Calculate new colour primaries which are located on the intersection of a line projected from the D50 white point through the RIMM colour primaries.
 - 2) These new colour primaries are shown in [Table 4](#).

Table 4 — Image file characteristics

	x	y
Red	0,734 7	0,265 3
Green	0,178 849	0,790 556
Blue	0,110 262	0,085 511
White Point	0,345 7	0,358 5

b) The second step defines the vignettes as follows.

- 1) Determine the difference between each step of vignette by uniformly dividing the black and white normalized range of L^* (0 to 100) into 4 096 steps.
- 2) Convert each normalized L^* value to a 32-bit floating-point Y value normalized to range from 0 to 1.
- 3) Using the primary, secondary, and white point chromaticities determine floating point XYZ values for each Y value in each ramp for each primary (red, green, blue), secondary (cyan, magenta, yellow) and tertiary (grey) colour.
- 4) Convert the resulting 4 096 normalized XYZ values to linear intermediate- $R_iG_iB_i$ values using Formula (4).

$$\begin{bmatrix} R_i \\ G_i \\ B_i \end{bmatrix} = \begin{bmatrix} 1,541\,320 & -0,341\,925 & -0,174\,964 \\ -0,596\,947 & 1,653\,134 & -0,093\,930 \\ 0,019\,079 & -0,052\,835 & 1,253\,705 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \quad (4)$$

- 5) Convert linear intermediate $R_iG_iB_i$ values to linear RIMM RGB values using Formula (5).

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 0,884\,227 & 0,030\,988 & 0,084\,963 \\ 0,000\,008 & 0,915\,043 & 0,084\,909 \\ 0,000\,000 & 0,030\,979 & 0,969\,295 \end{bmatrix} \begin{bmatrix} R_i \\ G_i \\ B_i \end{bmatrix} \quad (5)$$

- 6) Obtain 16-bit RIMM RGB component values R' , G' and B' corresponding to each linear RIMM RGB combination using Formula (6).

$$\begin{aligned} R' &= \text{Round}(65\,535 f(R)) \\ G' &= \text{Round}(65\,535 f(G)) \\ B' &= \text{Round}(65\,535 f(B)) \end{aligned} \quad (6)$$

where

$$f(C) = \begin{cases} (1,099C^{0,45} - 0,099) / 1,402\,278\,2; & 0,0 \leq C < 0,018 \\ 4,5C / 1,402\,278\,2 & ; \quad 0,018 \leq C \leq 2,0 \end{cases}$$

As shown in [Figure 3](#), image S3 consists of two vignettes for each of the primary, secondary and tertiary colours. For each of the primary and secondary vignettes, the upper vignette starts with black and the lower vignette starts with white. Both vignettes then change towards the most saturated colour of each hue from left to right. For the tertiary (grey) vignettes, the upper one starts with black changing towards white from left to right while in the lower one the order is reversed.

The frame surrounding all the vignettes, and the spaces between the individual vignettes, have a black and white normalized $L^* = 50$.

5 Electronic data

Image data are contained in 41 data files that are included in this part of ISO 12640. File names correspond to the image IDs as described in 4.5 and 4.6. Table 5 shows the file name, size, colour values 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. To verify data integrity, the check-sums given in Annex B shall be used.

The restrictions on the use of these image data files as described in Annex A shall apply.

Table 5 — Image file characteristics

File name	File size (bytes)	Height (pixels)	Width (pixels)	Colour space	Colour values	Descriptive name
NP01RGB.TIF	36 741 760	3 040	2 014	RGB	Three 16-bit values	Falls
NP02RGB.TIF	36 741 760	3 040	2 014	RGB	Three 16-bit values	Eiffel
NP03RGB.TIF	37 143 040	3 040	2 036	RGB	Three 16-bit values	Mickey
NP04RGB.TIF	72 732 928	2 848	4 256	RGB	Three 16-bit values	Butterfly
NP05RGB.TIF	73 416 448	2 864	4 272	RGB	Three 16-bit values	Threads
NP06RGB.TIF	73 416 448	2 864	4 272	RGB	Three 16-bit values	Fruits
NP07RGB.TIF	72 732 928	2 848	4 256	RGB	Three 16-bit values	Canal
NP08RGB.TIF	60 223 744	2 592	3 872	RGB	Three 16-bit values	WhiteFlowers
NP09RGB.TIF	61 895 232	2 408	4 284	RGB	Three 16-bit values	BarHarborPresunrise
NP10RGB.TIF	62 055 936	2 412	4 288	RGB	Three 16-bit values	BenJerrys
NP11RGB.TIF	73 273 344	2 848	4 288	RGB	Three 16-bit values	DelicateFlowers
NP12RGB.TIF	62 055 936	2 412	4 288	RGB	Three 16-bit values	DevilsBathtub
NP13RGB.TIF	73 273 344	2 848	4 288	RGB	Three 16-bit values	Exploratorium
NP14RGB.TIF	73 170 432	2 844	4 288	RGB	Three 16-bit values	GoldenGate
NP15RGB.TIF	61 837 440	2 408	4 280	RGB	Three 16-bit values	HancockSeedField
NP16RGB.TIF	61 837 440	2 408	4 280	RGB	Three 16-bit values	NiagaraFalls
NP17RGB.TIF	61 895 232	2 408	4 284	RGB	Three 16-bit values	RedwoodSunset
NP18RGB.TIF	73 273 344	2 848	4 288	RGB	Three 16-bit values	Route66Museum
NP19RGB.TIF	73 033 920	4 280	2 844	RGB	Three 16-bit values	SouthBranchKingsRiver
NP20RGB.TIF	73 273 344	2 848	4 288	RGB	Three 16-bit values	TupperLake
NP21RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	Chandelier
NP22RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	Clock
NP23RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	Meat
NP24RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	Peacock
NP25RGB.TIF	60 472 576	3 888	2 592	RGB	Three 16-bit values	BlueFace
NP26RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	PoundCake
NP27RGB.TIF	60 472 576	2 592	3 888	RGB	Three 16-bit values	LasVegas
NS01RGB.TIF	36 741 760	2 014	3 040	RGB	Three 16-bit values	Maple
NS02RGB.TIF	36 741 760	2 014	3 040	RGB	Three 16-bit values	River
NS03RGB.TIF	73 416 448	2 864	4 272	RGB	Three 16-bit values	Marker
NS04RGB.TIF	73 416 448	2 864	4 272	RGB	Three 16-bit values	Flowers
NS05RGB.TIF	73 416 448	2 864	4 272	RGB	Three 16-bit values	Fluorescence
NS06RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Hotel
NS07RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Pyramid
NS08RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Nile
NS09RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Felucca

Table 5 (continued)

File name	File size (bytes)	Height (pixels)	Width (pixels)	Colour space	Colour values	Descriptive name
NS10RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	CherryBlossom
NS11RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Iris
NS12RGB.TIF	37 143 040	2 036	3 040	RGB	Three 16-bit values	Wharf
NS13RGB.TIF	60 223 744	2 592	3 872	RGB	Three 16-bit values	Hiking
NS14RGB.TIF	62 055 936	2 412	4 288	RGB	Three 16-bit values	CadesCove
NS15RGB.TIF	73 273 344	2 848	4 288	RGB	Three 16-bit values	FourCornersStorm
NS16RGB.TIF	60 223 744	2 592	3 872	RGB	Three 16-bit values	Sunset
NS17RGB.TIF	60 472 576	3 888	2 592	RGB	Three 16-bit values	Headlight
S1RGB.TIF	49 800 112	2 116	3 922	RGB	Three 16-bit values	Colour chart 1
S2RGB.TIF	24 600 688	1 252	3 274	RGB	Three 16-bit values	Colour chart 2
S3RGB.TIF	66 604 288	2 608	4 256	RGB	Three 16-bit values	Colour vignettes

Annex A

(normative)

Guidance for use of digital data

A.1 General

To ensure that these images can be used successfully for the testing and comparisons for which they are intended, all use shall conform to the procedures and guidelines described in Clauses [A.2](#) and [A.3](#).

A.2 Guidelines for use

A.2.1 Reproduction

All reproductions of these images shall contain an annotation identifying this part of ISO 12640 as the data source and shall retain the label included in the image data.

A.2.2 Modification

Any images created by modification of these data (derivative images) shall also have a visible identifier added within the image. The accompanying material shall include a tabulation of the steps used to modify the image data including all editing steps used as well as any data rescaling or interpolation.

A.2.3 Cropping

These images should not be cropped.

A.3 Guidelines for distribution and sharing

A.3.1 General

Many of the intended uses of these images require that they be used at several locations and/or by several participants in test programs. The following uses have been interpreted to be acceptable and allowable by ISO.

A.3.2 For-profit sale

Neither the data, nor images printed from these data, shall be sold “for-profit” except as defined in [A.3.3](#).

A.3.3 Test and evaluation packages

It shall be permitted to include the data corresponding to these images, or derivations of these images, as part of test and evaluation packages to be sold or provided free of charge where a licensed copy of this part of ISO 12640 is included as part of the complete package.

NOTE It is recognized that certain test and evaluation packages that will make use of these images might need to embed the data to be used within other data processing procedures. The inclusion of an authentic copy of this part of ISO 12640, obtained from the appropriate standards agency, as part of the package will allow the inclusion of similar or derived data as required within the package.

A.3.4 Test and evaluation programs

Copies of these data files, or derivative files, may be exchanged between participants in test and evaluation programs. The sponsoring organization shall be capable of showing ownership of an authentic copy of this part of ISO 12640.

A.3.5 Reports

It shall be permitted to display these images as part of the report of test programs, or in advertisements, as long as the organization sponsoring the display is in possession of an authentic copy of this part of ISO 12640.

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Annex B (normative)

Check-sum data

For questions of data integrity, the check-sums given in [Table B.1](#) shall be used. These values are calculated by summing each image plane (R, G, B) with a one-byte accumulator. The overflow bit of the accumulator is ignored. The total accumulation, T, for all three planes is also shown. These data are shown in both hex and decimal notation. These check-sums apply only to the image data and exclude any headers.

Table B.1 — Check-sum

Image	Hex				Decimal			
	R	G	B	T	R	G	B	T
NP01 Falls	73	86	C4	BD	115	134	196	189
NP02 Eiffel	F1	EB	1E	FA	241	235	30	250
NP03 Mickey	F4	7A	7F	ED	244	122	127	237
NP04 Butterfly	C6	7A	18	58	198	122	24	88
NP05 Threads	27	C3	F9	E3	39	195	249	227
NP06 Fruits	CE	D6	8C	30	206	214	140	48
NP07 Canal	50	D9	18	41	80	217	24	65
NP08 WhiteFlowers	D1	E5	AD	63	209	229	173	99
NP09 BarHarborPresunrise	6B	D7	1C	5E	107	215	28	94
NP10 BenJerrys	8B	5C	96	7D	139	92	150	125
NP11 DelicateFlowers	F2	88	66	E0	242	136	102	224
NP12 DevilsBathtub	7F	2	B1	32	127	2	177	50
NP13 Exploratorium	48	B7	85	84	72	183	133	132
NP14 GoldenGate	6B	51	18	D4	107	81	24	212
NP15 HancockSeedField	AE	30	33	11	174	48	51	17
NP16 NiagaraFalls	E2	89	21	8C	226	137	33	140
NP17 RedwoodSunset	D6	D	71	54	214	13	113	84
NP18 Route66Museum	A6	B4	E7	41	166	180	231	65
NP19 SouthBranchKingsRiver	D9	3	25	1	217	3	37	1
NP20 TupperLake	16	92	47	EF	22	146	71	239
NP21 Chandelier	FA	9C	A8	3E	250	156	168	62
NP22 Clock	CA	D2	E	AA	202	210	14	170
NP23 Meat	DA	19	F1	E4	218	25	241	228
NP24 Peacock	58	3D	D1	66	88	61	209	102
NP25 BlueFace	4E	13	3E	9F	78	19	62	159
NP26 PoundCake	47	5E	5D	2	71	94	93	2
NP27 LasVegas	4F	13	88	EA	79	19	136	234
NS01 Maple	0	96	69	FF	0	150	105	255
NS02 River	36	4D	2B	AE	54	77	43	174
NS03 Marker	58	6	2C	8A	88	6	44	138
NS04 Flowers	77	EE	A	6F	119	238	10	111
NS05 Fluorescence	E5	BB	EE	8E	229	187	238	142

Table B.1 (continued)

Image	Hex				Decimal			
	R	G	B	T	R	G	B	T
NS06 Hotel	49	2F	E0	58	73	47	224	88
NS07 Pyramid	BF	DA	A	A3	191	218	10	163
NS08 Nile	7	45	B0	FC	7	69	176	252
NS09 Felucca	33	59	C3	4F	51	89	195	79
NS10 CherryBlossom	5B	36	14	A5	91	54	20	165
NS11 Iris	AF	4D	2F	2B	175	77	47	43
NS12 Wharf	74	F4	47	AF	116	244	71	175
NS13 Hiking	41	3B	A3	1F	65	59	163	31
NS14 CadesCove	F6	C6	9C	58	246	198	156	88
NS15 FourCornersStorm	6A	3E	5B	3	106	62	91	3
NS16 Sunset	36	F	CE	13	54	15	206	19
NS 17 Headlight	16	94	64	E	22	148	100	14
S1 Colour chart 1	A8	43	66	51	168	67	102	81
S2 Colour chart 2	91	D6	59	C0	145	214	89	192
S3 Colour vignettes	4D	4A	CC	63	77	74	204	99

Annex C (informative)

Typical TIFF/IT file header used for image files

The TIFF/IT file header encoding of the colour picture file named “NP01RGB.TIF”, “Falls”, is shown below. This encoding uses tags defined in TIFF/IT. The PhotometricInterpretation tag is set to 2 (RGB) in this file.

The following fields are not included and take their default values:

- NewSubfileType = 0;
- Orientation = 1 (load from top left, horizontally);
- RowsPerStrip = $2^{32} - 1$ (only one strip);
- PlanarConfiguration = 1 (pixel interleaved).

The symbol “n” represents a null byte, and “x” represents a “don’t care” hexadecimal digit for padding data.

Table C.1 — Typical TIFF/IT file header used for image files

Offsets	Value					Description
		TIFF/IT File Header				
00000000	4D4D					Byte order “MM”(big-endian)
00000002	002A					Version number: 42
00000004	00000008					Pointer to the 1st: the 1st IFD begins in 8th byte in a file
		the 1st IFD				
00000008	0010					Number of in this IFD: 16 entries in this IFD
	Tag#	Type	Count	Value-offset		
0000000A	0100	0003	00000001	07DExxxx	256	ImageWidth: 2 014 pixels/line
00000016	0101	0003	00000001	0BE0xxxx	257	ImageLength: 3 040 lines/image
00000022	0102	0003	00000003	00000200	258	BitsPerSample: pointer to the area of 00000200h
0000002E	0103	0003	00000001	0001xxxx	259	Compression: 1(no compression)
0000003A	0106	0003	00000001	0002xxxx	262	PhotometricInterpretation: 2 (for RGB image)
00000046	010E	0002	00000009	00000206	270	ImageDescription: pointer to the area of 00000206h
00000052	010F	0002	0000000E	00000220	271	Make (Vendor name): pointer to the area of 00000220h
0000005E	0111	0004	00000001	00001900	273	StripOffsets: 00001900h (pointer to the image data)
0000006A	0115	0003	00000001	0003xxxx	277	SamplesPerPixel: 3
00000076	0117	0004	00000001	02308980	279	StripByteCounts: 36,735,360 bytes in the strip

Table C.1 (continued)

Offsets	Value					Description
00000082	011A	0005	00000001	00000230	282	XResolution: pointer to the area of 00000230h
0000008E	011B	0005	00000001	00000238	283	YResolution: pointer to the area of 00000238h
0000009A	0128	0003	00000001	0003xxxx	296	ResolutionUnit: cm
000000A6	0132	0002	00000014	00000240	306	DateTime: pointer to the area of 00000240h
000000B2	8298	0002	00000029	00000258	33432	Copyright: pointer to the area of 00000298h
000000BE	8773	0007	000015A4	00000282	34675	ICC profile: pointer to the area of 00000282h
000000CA	00000000					Pointer to next IFD: None
		Value area				
00000200	0010	0010	0010			BitsPerSample: 16,16,16 (16 bits/sample for each separation)
00000206	46 41 4C 4C 53 52 47 42 00 xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx					ImageDescription: "FALLSRGBn"
00000220	49 53 4F 20 54 43 31 33 30 2F 57 47 32 00 xx xx					Make(Vendor name): "ISO TC130/WG2n"
00000230	00005DC0		00000064			XResolution: 24000/100 (240 pixels/cm)
00000238	00005DC0		00000064			YResolution: 24000/100 (240 pixels/cm)
00000240	32 30 30 39 3A 30 34 3A 30 31 20 31 30 3A 30 30 3A 30 30 00 xx xx xx xx					DateTime: "2009:04:01 10:00:00n" (April 1, 2009 at 10:00:00)
00000258	43 6F 70 79 72 69 67 68 74 20 32 30 31 30 20 49 53 4F 2C 20 41 6C 6C 20 72 69 67 68 74 73 20 72 65 73 65 72 76 65 64 2E 00 xx					Copyright: "Copyright 2010 ISO, All rights reserved.n"
00000282 – 00001825						ICC profile data
00001826 – 000018FF						not used
		Image data				
00001900 – 0230A27F						Image data area is from 00001900h to 0230A27Fh

Annex D (informative)

Label text insertion

It should be noted that each image has a text label, “ISO 12640-5”, inserted in the image. Pixels representing this text have a coded value of 65 535.

The position of the outer boundaries of the text is defined by a rectangle produced from the coordinates of two of the corners as shown in [Figure D.1](#). The position of the text in each image (in terms of number of pixels) is given in [Table D.1](#).

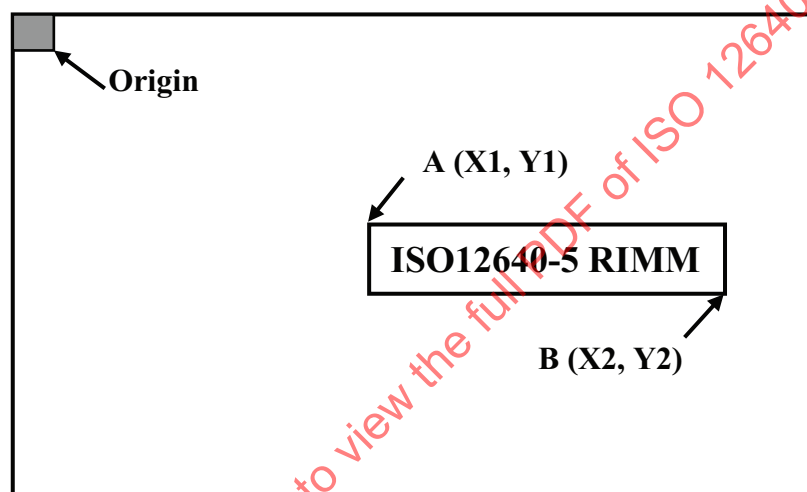


Figure D.1 — Definition of the coordinates of the text insertions

Table D.1 — Position of the text in each image

Image	Name	A (X1,Y1)	B (X2,Y2)
NP01	Falls	(25, 2 990)	(338, 3 016)
NP02	Eiffel	(1 514, 2 990)	(1 827, 3 016)
NP03	Mickey	(1 536, 2 990)	(1 849, 3 016)
NP04	Butterfly	(50, 4 206)	(363, 4 232)
NP05	Threads	(3 772, 25)	(4 085, 51)
NP06	Fruits	(50, 25)	(363, 51)
NP07	Canal	(3 756, 2 798)	(4 069, 2 824)
NP08	WhiteFlowers	(50, 50)	(363, 76)
NP09	BarHarborPresunrise	(50, 25)	(363, 51)
NP10	BenJerrys	(50, 25)	(363, 51)
NP11	DelicateFlowers	(50, 25)	(363, 51)
NP12	DevilsBathtub	(50, 2362)	(363, 2388)
NP13	Exploratorium	(50, 25)	(363, 51)
NP14	GoldenGate	(50, 25)	(363, 51)
NP15	HancockSeedField	(3780, 25)	(4093, 51)
NP16	NiagaraFalls	(50, 2358)	(363, 2384)

Table D.1 (continued)

Image	Name	A (X1,Y1)	B (X2,Y2)
NP17	RedwoodSunset	(50, 25)	(363, 51)
NP18	Route66Museum	(50, 25)	(363, 51)
NP19	SouthBranchKingsRiver	(50, 4230)	(363, 4256)
NP20	TupperLake	(50, 25)	(363, 51)
NP21	Chandelier	(3388, 2542)	(3701, 2568)
NP22	Clock	(50, 2542)	(363, 2568)
NP23	Meat	(50, 25)	(363, 51)
NP24	Peacock	(50, 25)	(363, 51)
NP25	BlueFace	(50, 3838)	(363, 3864)
NP26	PoundCake	(3388, 2542)	(3701, 2568)
NP27	LasVegas	(3388, 25)	(3701, 51)
NS01	Maple	(2 540, 1 964)	(2 853, 1 990)
NS02	River	(2 590, 25)	(2 903, 51)
NS03	Marker	(50, 2 814)	(363, 2 840)
NS04	Flowers	(50, 25)	(363, 51)
NS05	Fluorescence	(50, 25)	(363, 51)
NS06	Hotel	(50, 1 986)	(363, 2 012)
NS07	Pyramid	(2 540, 25)	(2 853, 51)
NS08	Nile	(50, 25)	(363, 51)
NS09	Felucca	(50, 25)	(363, 51)
NS10	CherryBlossom	(50, 1 986)	(363, 2 012)
NS11	Iris	(50, 25)	(363, 51)
NS12	Wharf	(2 540, 25)	(2 853, 51)
NS13	Hiking	(50, 50)	(363, 76)
NS14	CadesCove	(3788, 25)	(4101, 51)
NS15	FourCornersStorm	(50, 25)	(363, 51)
NS16	Sunset	(50, 2542)	(363, 2568)
NS17	Headlight	(3388, 2542)	(3701, 2568)
S1	Colour chart 1	(3 560, 2 081)	(3 873, 2 107)
S2	Colour chart 2	(2 912, 10)	(3 225, 36)
S3	Colour vignettes	(3 870, 2 554)	(4 183, 2 580)

Annex E (informative)

Histogram and colour gamut

In order to prepare statistical data for each image, a resampled image was created. This image was produced by averaging groups of 16×16 pixels in the image to produce an image 1/16 the size of the original image. A histogram of the *R*, *G* and *B* values of each reduced size natural image is shown along with an *xy*-chromaticity plot of its colour gamut in [Figures E.1](#) to [E.47](#).

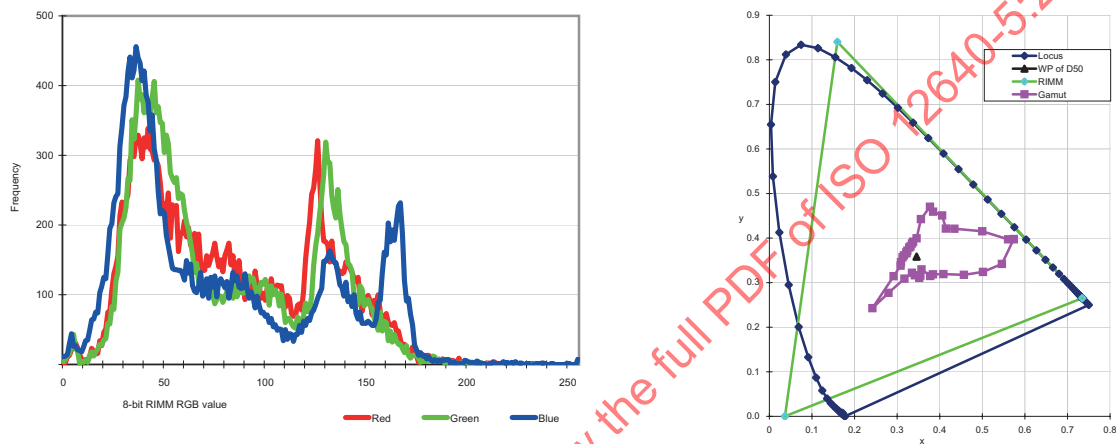


Figure E.1 — Histogram and *xy*-chromaticity plot of RIMM RGB for NP01 Falls

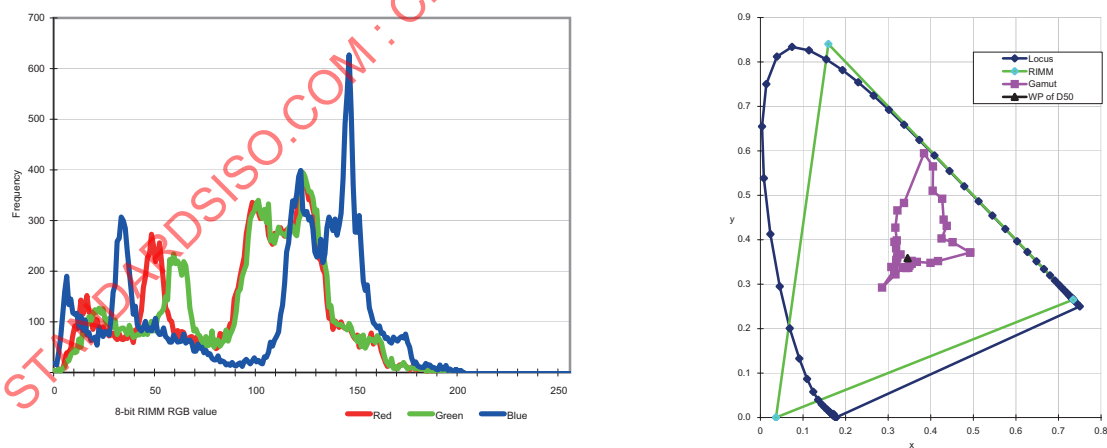


Figure E.2 — Histogram and *xy*-chromaticity plot of RIMM RGB for NP02 Eiffel

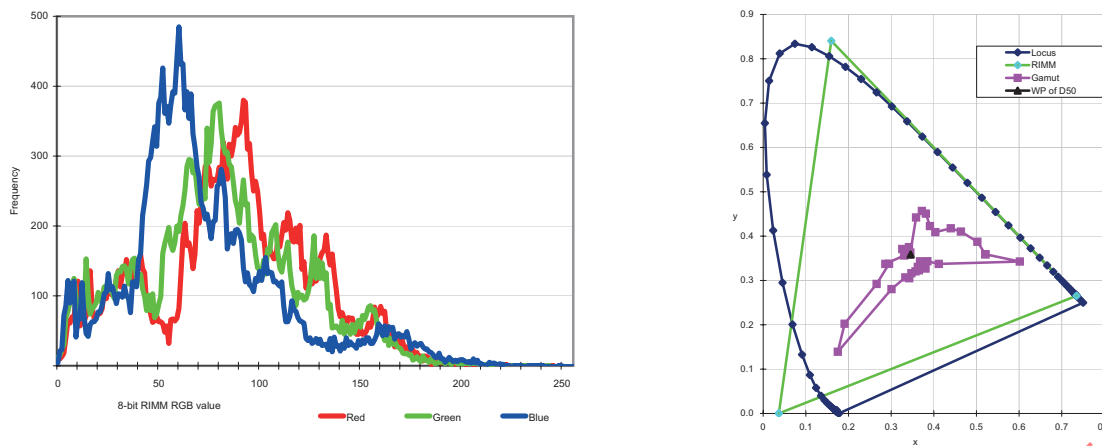


Figure E.3 — Histogram and xy-chromaticity plot of RIMM RGB for NP03 Mickey

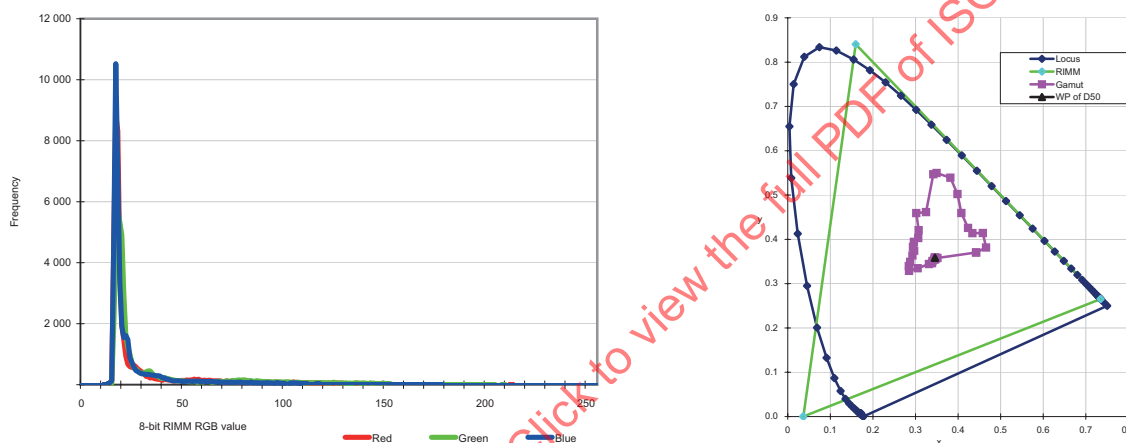


Figure E.4 — Histogram and xy-chromaticity plot of RIMM RGB for NP04 Butterfly

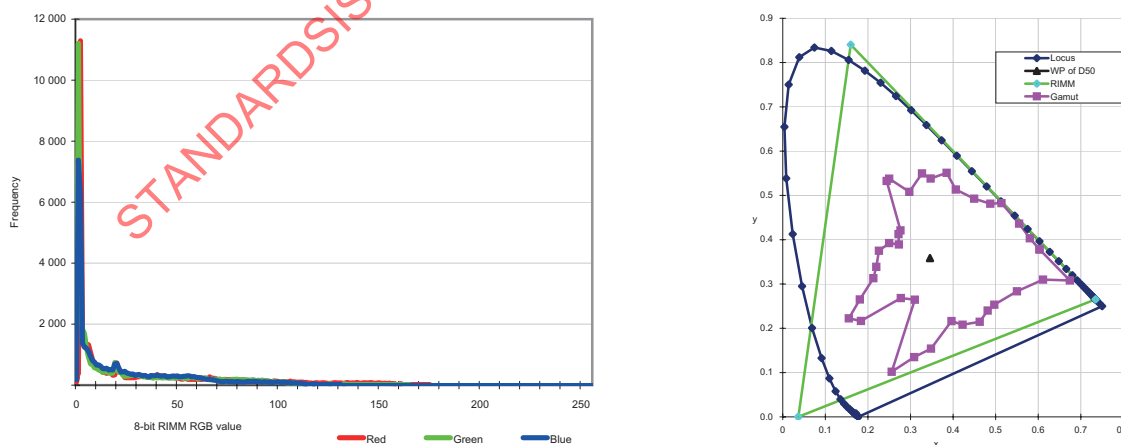


Figure E.5 — Histogram and xy-chromaticity plot of RIMM RGB for NP05 Threads

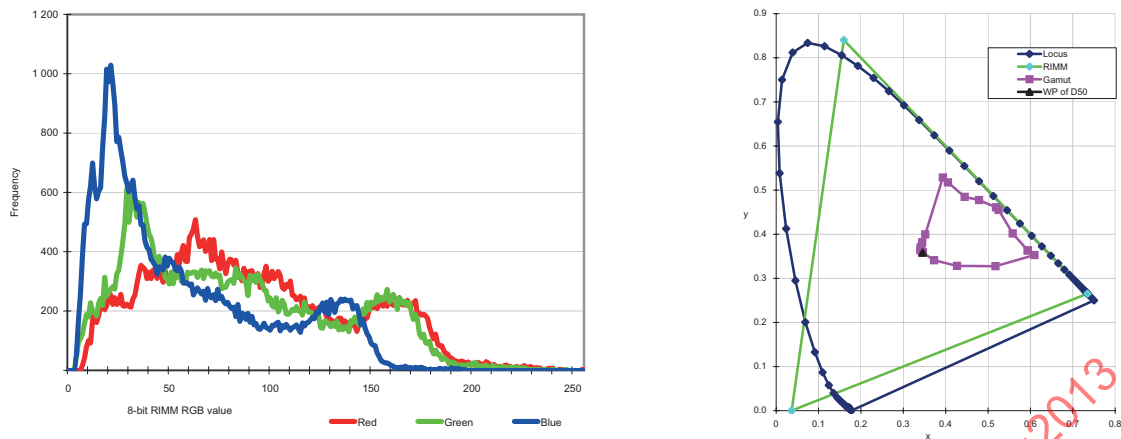


Figure E.6 — Histogram and xy-chromaticity plot of RIMM RGB for NP06 Fruits

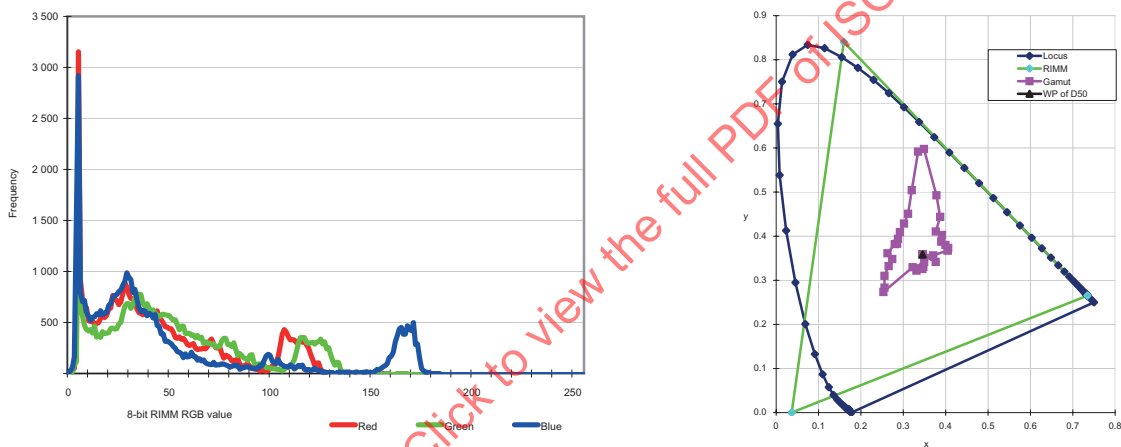


Figure E.7 — Histogram and xy-chromaticity plot of RIMM RGB for NP07 Canal

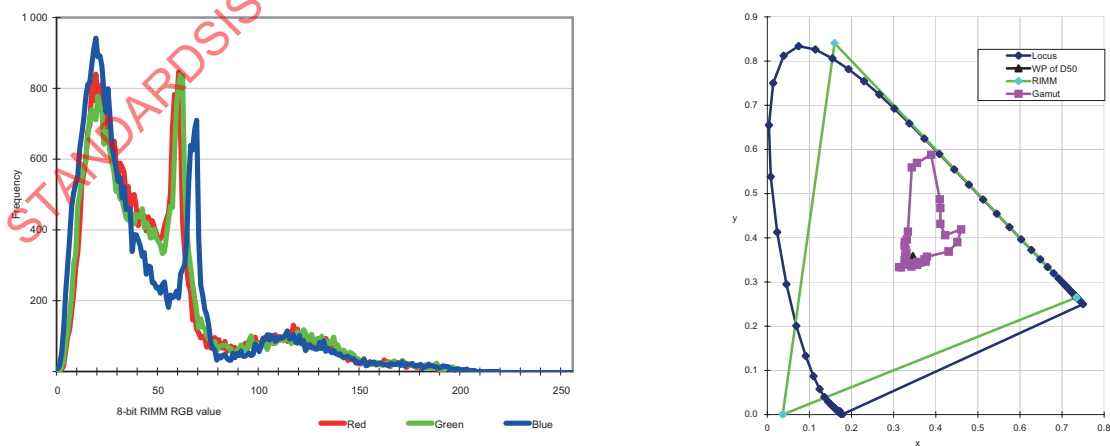


Figure E.8 — Histogram and xy-chromaticity plot of RIMM RGB for NP08 WhiteFlowers

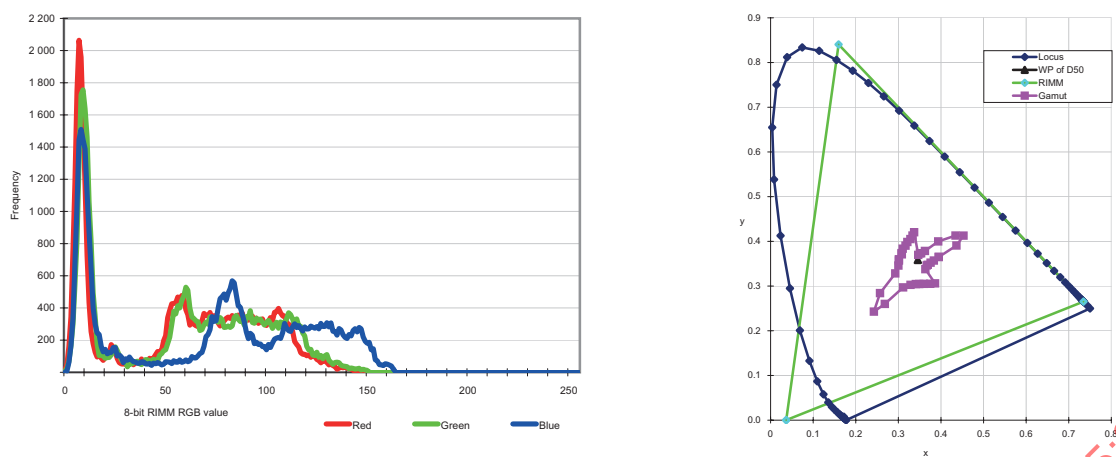


Figure E.9 — Histogram and xy-chromaticity plot of RIMM RGB for NP09 BarHarborPresunrise

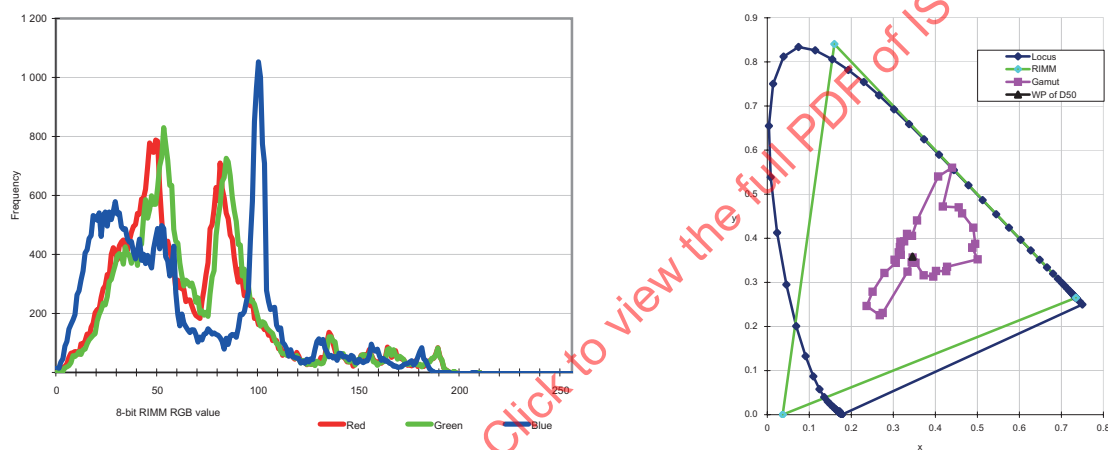


Figure E.10 — Histogram and xy-chromaticity plot of RIMM RGB for NP10 BenJerrys

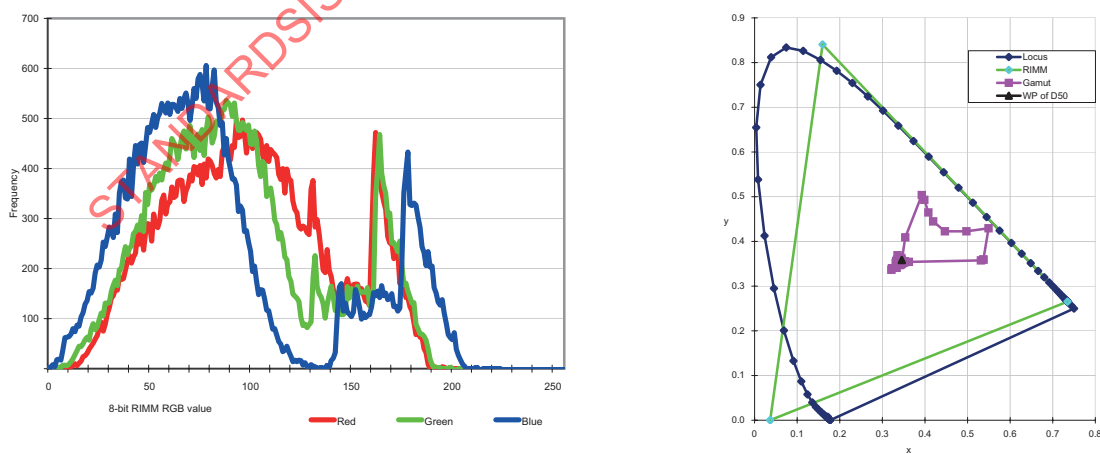


Figure E.11 — Histogram and xy-chromaticity plot of RIMM RGB for NP11 DelicateFlowers

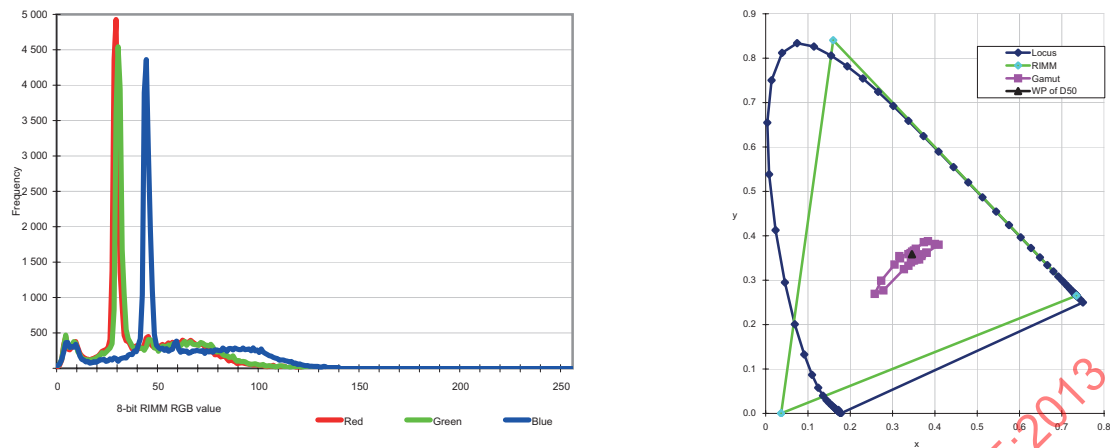


Figure E.12 — Histogram and xy-chromaticity plot of RIMM RGB for NP12 DevilsBathtub

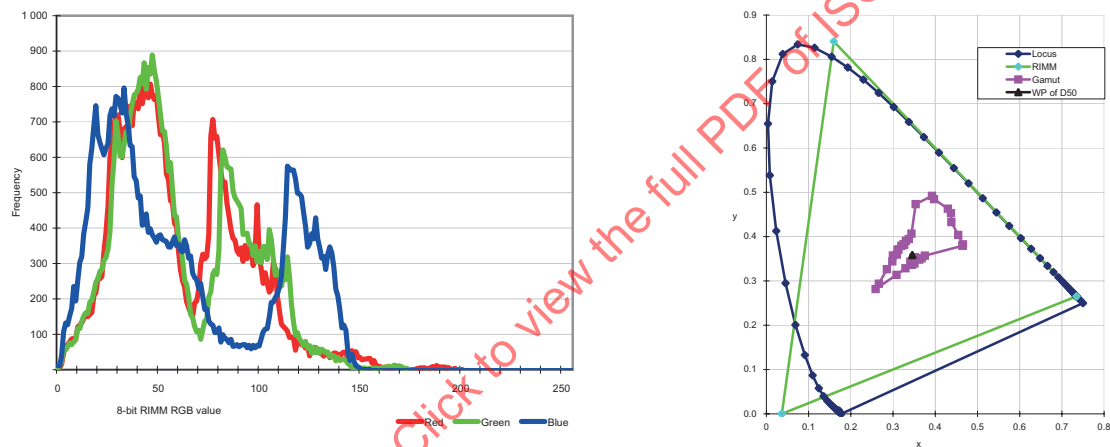


Figure E.13 — Histogram and xy-chromaticity plot of RIMM RGB for NP13 Exploratorium

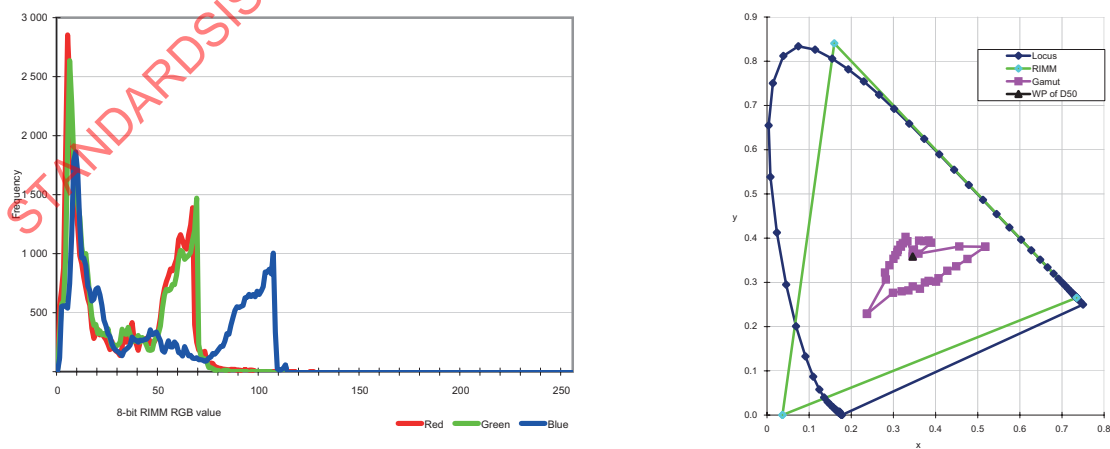


Figure E.14 — Histogram and xy-chromaticity plot of RIMM RGB for NP14 GoldenGate

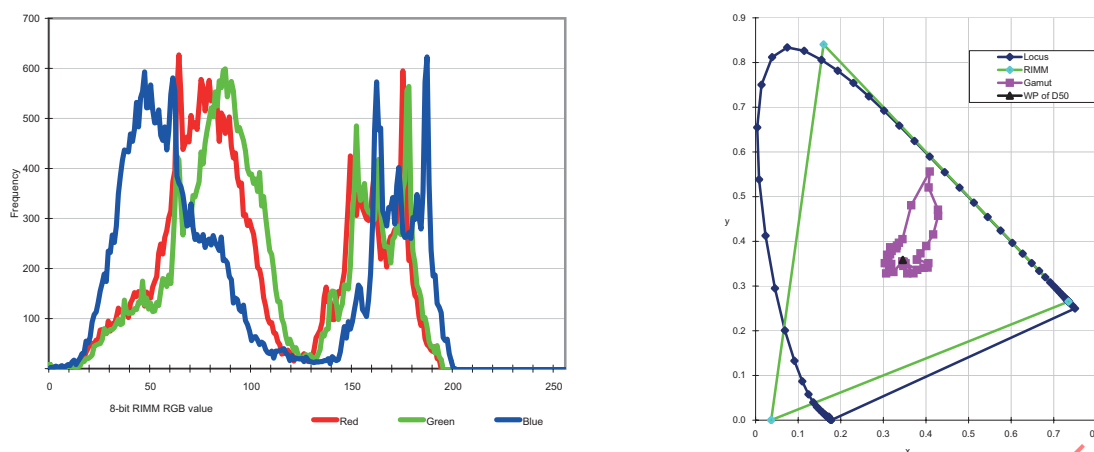


Figure E.15 — Histogram and xy-chromaticity plot of RIMM RGB for NP15 HancockSeedField

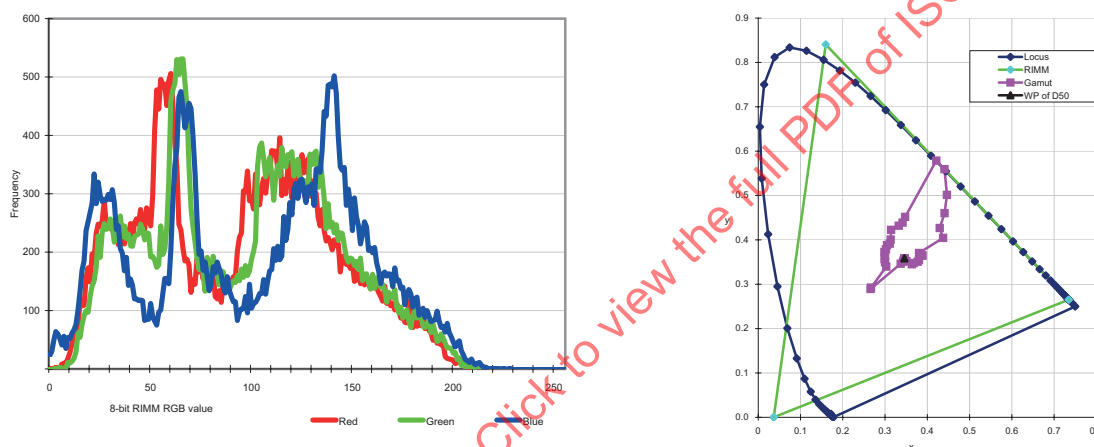


Figure E.16 — Histogram and xy-chromaticity plot of RIMM RGB for NP16 NiagaraFalls

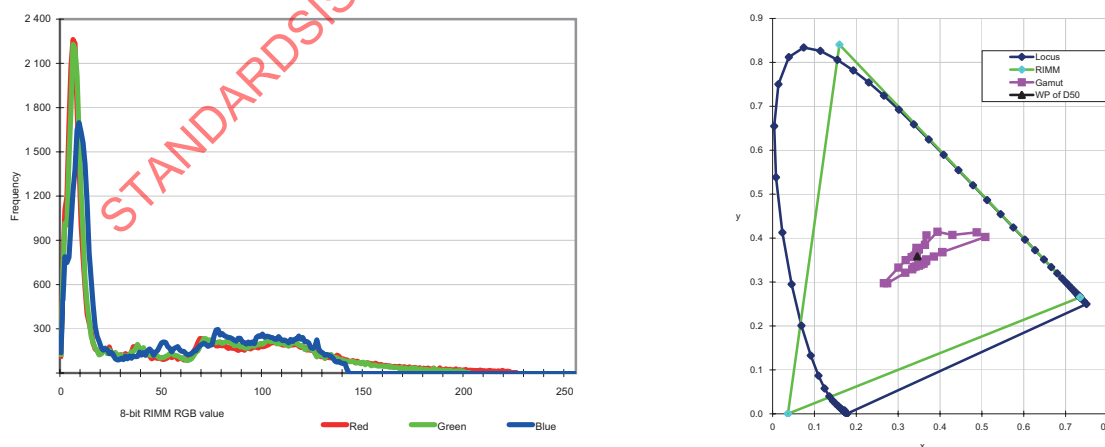


Figure E.17 — Histogram and xy-chromaticity plot of RIMM RGB for NP17 RedwoodSunset