

## Glossary of terms

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This glossary of terms contains definitions of terminology commonly used in colour imaging (including digital photography and printing), colour reproduction and management, and colour and density measurement. Most are taken from the ICC specification, International Standards, or CIE publications. In such cases the specification from which they have been obtained is specified. In some cases minor changes have been made, or the notes associated with these definitions deleted, either for the purposes of clarity, or to make their use more general than the industry specific specification sometimes defined. In such cases the term has been designated as "derived from".

Since some of the terms are appropriate to more than one of the categories listed users may want to search the document if they cannot find the term they want in the category they think is relevant.

### ***Colour Reproduction and Management***

#### **additive RGB colour**

colour formed by mixing light from a set of primary light sources, usually red, green and blue.

#### **additive RGB colour space**

a 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. [ISO 12231]

NOTE 1 A simple linear 3x3 matrix 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 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.

#### **colour management (digital imaging)**

communication of the associated data required for unambiguous interpretation of colour content data, and application of colour data conversions, as required, to produce the intended reproductions. [ICC.1]

NOTE 1 Colour content may consist of text, line art, graphics, and pictorial images, in raster or vector form, all of which may be colour managed.

NOTE 2 Colour management considers the characteristics of input and output devices in determining colour data conversions for these devices.

## **colour rendering**

mapping of image data representing the colour-space coordinates of the elements of a scene or original to output-referred image data representing the colour-space coordinates of the elements of a reproduction. [Derived from ISO 12231]

NOTE 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.

## **colour re-rendering**

mapping of picture-referred image data appropriate for one specified real or virtual imaging medium and viewing conditions to picture-referred image data appropriate for a different real or virtual imaging medium and/or viewing conditions. [See ISO 12231]

NOTE Colour re-rendering generally consists of one or more of the following: compensating for differences in the viewing conditions, compensating for differences in the dynamic range and/or colour gamut of the imaging media, and applying preference adjustments.

Editor's note: From an ICC perspective it may be useful to think of colour rendering as a procedure in which there is a change in image state on one side of the PCS (but not both), and colour re-rendering as a change in image state on both sides of the PCS. These should be compared to matching in which a colorimetric or appearance match is achieved and there is no change in image state.

## **device characterization**

defining the relationship between device values and tristimulus values, or their derivatives.

## **device dependent colour space**

colour space defined by the characteristics of a real or idealized imaging device. [ISO 12231]

NOTE Device-dependent colour spaces having a simple functional relationship to CIE colorimetry can also be categorized as colorimetric colour spaces. For example, additive RGB colour spaces corresponding to real or idealized CRT displays can be treated as colorimetric colour spaces.

## **film rendering transform**

mapping of image data representing measurements of a photographic negative to output-referred image data representing the colour-space coordinates of the elements of a reproduction. [ISO 12231]

## **film unrendering transform**

mapping of image data representing measurements of a photographic negative to scene-referred image data representing estimates of the colour-space coordinates of the elements of the original scene. [ISO 12231]

## **gamut mapping**

mapping of the colour-space coordinates of the elements of a source image to the colour-space coordinates of the elements of a reproduction to compensate for differences in the source and output medium colour gamut capability. [Derived from ISO 12231]

NOTE The term gamut mapping is somewhat more restrictive than the term colour rendering because gamut mapping is performed on colorimetry which has already been adjusted to compensate for viewing condition differences and viewer preferences, although these processing operations (gamut mapping and colour rendering) are frequently combined in reproduction and preferred-reproduction models.

## **global colour change**

change to the colours in an image (often selectively by colour region) applied consistently to all parts of the image. [ISO 12640-3]

NOTE This is in contrast to a local colour change where selected spatial areas of an image are changed separately from the rest of the image area.

## **ICC colour management**

method for the controlled conversion of colour data from one colour encoding to another, by means of ICC profiles. [Derived from ISO 12231 and ISO 12647-1]

## **ICC (International Color Consortium)**

industry body responsible for the ICC profile specification and colour management architecture. [ISO 12647-1]

## **ICC profile**

set of transforms from one colour encoding to another, e.g. from device colour coordinates to profile connection space, prepared in accordance with ICC.1. [Derived from ISO 12231 and ISO 12647-1]

## **medium black point**

lowest luminance neutral that can be produced by an imaging medium in normal use, measured using the specified measurement geometry. [ISO 12231]

NOTE It is generally desirable to specify a medium black point that has the same chromaticity as the medium white point.

## **medium white point**

highest luminance neutral that can be produced by an imaging medium in normal use, measured using the specified measurement geometry. [ISO 12231]

## **preferred-reproduction model**

mathematical model that produces transformations which are applied to scene- or original-referred image data to produce image data describing a pleasing reproduction. [ISO 12232:1]

NOTE Preferred-reproduction models are different from reproduction models in that the pleasing reproduction need not be an attempt to reproduce the appearance of the original. In fact, what is considered pleasing may depend on viewer preferences. The transformations produced by a preferred-reproduction model are generally dependent on the characteristics of the scene or original and the output medium.

## **Profile Connection Space (ICC PCS)**

abstract colour space defined by the International Color Consortium providing a standard connection point for combining ICC source and destination profiles. [Derived from ICC.1 and ISO 12231]

NOTE Unlike earlier versions of the specification, there are two variations of the PCS defined in the current ICC specification. One is an original-referred variation for colorimetric intent profiles, the other is a standard output-referred variation for perceptual intent profiles.

## **reproduction model**

mathematical model that produces transformations which are applied to scene- or original-

referred image data to produce image data describing a reproduction which is as close as possible to being an appearance match to the original. [ISO 12231]

NOTE Transformations produced by reproduction models will generally depend on the luminance ratio and colour gamut of the scene or original and the output medium.

### **rendering intent**

style of mapping colour values from one image description to another. [Derived from ICC.1]

NOTE ICC defines four rendering intents (ICC-absolute colorimetric, relative colorimetric, perceptual and saturation).

### **subtractive colour space**

colour space obtained by combining colorants which absorb some of the light reflected or transmitted by a substrate. Typical colorants are Cyan, Magenta and Yellow, with the addition of Black in many printing application.

### **tone reproduction**

relationship of one of the luminance, luminance factor,  $L^*$ , decadic logarithm of luminance, or density in a scene or original to one of the luminance, luminance factor,  $L^*$ , decadic logarithm of luminance, or density in a reproduction [ISO 12231]

NOTE 1 It is not necessary that corresponding quantities be plotted together, although generally linear quantities are not plotted with respect to logarithmic quantities, and vice-versa.

NOTE 2 The term tone reproduction, also called system tone reproduction, should only be applied to those processes that both start and end with a visible image. A visible image may be a scene, hardcopy, or softcopy. The term tone reproduction should not be used with respect to the characteristics of either an input or an output device taken by itself; such devices are system components but they are not systems. So, for example, an OECF of an input device or the tonescale of an output device (such as a printer characteristic curve) do not exemplify tone reproduction.

## ***Colour and Density Measurement***

### **absolute colorimetric coordinates**

tristimulus values, or other colorimetric coordinates derived from tristimulus values, where the numerical values correspond to the magnitude of the physical stimulus. [Derived from ISO 12231]

NOTE 1 When CIE 1931 2° standard observer colour matching functions are used, the Y value corresponds to the luminance, not the luminance factor (or some scaled value thereof).

NOTE 2 This should not be confused with the definition of ICC-absolute colorimetry.

### **achromatic (perceived) colour**

colour devoid of hue, in the perceptual sense. [CIE publication 17.4, 845-02-26]

NOTE 1 The colour names white, grey and black are commonly used or, for transmitting objects, colourless and neutral.

### **adapted white**

colour stimulus that an observer who is adapted to the viewing environment would judge to be perfectly achromatic and to have a luminance factor of unity; i.e., have absolute colorimetric coordinates that an observer would consider to be the perfect white diffuser. [ISO 12231]

NOTE The adapted white may vary within a scene.

### **chromatic (perceived) colour**

perceived colour possessing hue, in the perceptual sense. [CIE publication 17.4, 845-02-27].

### **CIELAB colour difference; CIE 1976 $L^*$ , $a^*$ , $b^*$ colour difference ( $\Delta E_{ab}$ )**

difference between two colour stimuli defined as the Euclidean distance between the points representing them in  $L^*$ ,  $a^*$ ,  $b^*$  space. [CIE publication 17.4, 845-03-55]

### **CIELAB colour space, CIE 1976 $L^*$ $a^*$ $b^*$ colour space**

three-dimensional, approximately uniform colour space obtained by applying a cube-root transformation to CIE 1931 tristimulus values  $X$ ,  $Y$ ,  $Z$ , or CIE 1964 tristimulus values  $X_{10}$ ,  $Y_{10}$ ,  $Z_{10}$ , to obtain  $L^*$ ,  $a^*$ ,  $b^*$  which are plotted in rectangular co-ordinates. [Derived from ASTM E-284 and CIE publication 17.4, 845-03-56]

### **colorimeter**

instrument for measuring colorimetric quantities, such as the tristimulus values of a colour stimulus. [CIE publication 17.4, 845-05-18]. (See *spectrocolorimeter and tristimulus colorimeter*)

### **colorimetric colour space**

colour space having an exact and simple relationship to CIE colorimetric values. [ISO 12231]

NOTE Colorimetric colour spaces include those defined by CIE (e.g., CIE XYZ, CIELAB, CIELUV, etc.), as well as colour spaces that are simple transformations of those colour spaces (e.g., additive RGB colour spaces).

### **colour appearance model**

(See image stimulus appearance model, single stimulus appearance model)

### **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. [ISO 12231]

### **colour matching functions**

tristimulus values of monochromatic stimuli of equal radiant power. [CIE Publication 17.4, 845-03-23]

### **colour space**

geometric representation of colours in space, usually of three dimensions. [CIE Publication 17.4, 845-03-25]

### **colour space white point**

colour stimulus to which colour space values are normalized. [ISO 12231]

NOTE The colour space white point may or may not correspond to the assumed adapted white point and/or the reference medium white point for a colour image encoding.

**diffuse reflection**

diffusion by reflection in which, on the macroscopic scale, there is no regular reflection. [CIE Publication 17.4, 845-04-47]

**Equivalent Neutral Density (END)**

visual density or effective visual density of an analysis primary or rendering colorant, when it is combined with the amounts of the other system primaries or colorants required to produce a visual neutral. [ISO 12231]

**gloss**

mode of appearance by which reflected highlights of objects are perceived as superimposed on the surface due to the directionally selective properties of that surface. [CIE Publication 17.4, 845-04-73]

**incident flux**

Flux incident on the sampling aperture defining the specimen area on which the measurement is made. [ISO 5-1]

**image appearance model**

mathematical model that uses information about viewing conditions and other colours in an image to estimate the subjective appearance of any element of an image from colorimetric measurements of the image. [Derived from ISO 12231]

NOTE 1 An image appearance model can describe the elements of either a scene, an original, or a reproduction, but it does not consider the characteristics of any potential output medium for subsequent reproduction. [Editor's note: the characteristics of the output medium may be relevant to an appearance model if the medium itself influences the visual state – such as chromatic adaptation].

NOTE 2 There is no general consensus on the appropriate form for an image appearance model. There is an expectation that reproducing the colorimetric coordinates of every colour in an image will result in a reproduction of the appearance of the entire image, as long as the viewing condition and size of the image remains the same, and it is possible to reproduce the colorimetric coordinates of every colour in the image.

NOTE 3 An image appearance model followed by its inverse is appropriate for use as a reproduction model provided the reproduction medium does not impose any limitations on the colours to be reproduced in the image.

**luminance factor**

ratio of the luminance of the surface element in the given direction to that of a perfect reflecting or transmitting diffuser identically illuminated. [CIE Publication 17.4, 845-04-69]

**regular reflection (or specular reflection)**

reflection in accordance with the laws of geometrical optics, without diffusion. [CIE Publication 17.4, 845-04-45]

**reflectance factor ( $R_r$ )**

ratio of the measured reflected flux from the specimen to the measured reflected flux from a perfect-reflecting and perfect-diffusing material located in place of the specimen. [ISO 5-4]

**reflection densitometer**

instrument which measures reflectance factor density. [ISO 12647-1]

**reflection density (or reflectance factor (optical) density)**

logarithm to base ten of the reciprocal of the reflectance factor. [ISO 5-4 and CIE Publication 17.4, 845-04-67]

**reflectometer**

photometer for measuring quantities pertaining to reflection. [CIE Publication 17.4, 845-05-26]

**relative density**

density from which the density of a reference such as the film base, or the unprinted print substrate, has been subtracted. [ISO 12647-1]

**sampling aperture**

area of the sample that contributes to the measurement. [ISO 13655]

NOTE This is not necessarily the same as the illumination aperture which is the area of the sample illuminated by the instrument or the mechanical aperture created by an opaque mask used to position the densitometer on the specimen. ISO 5-4 makes very specific requirements on the relationship between each of these.

**sampling aperture size**

dimensions of the surface area of the sample that contributes to the measurement of the reflectance or transmittance factor (or reflection or transmission density), governed by the design of the instrument. [Derived from ISO 12647-1]

**single-stimulus appearance model**

mathematical model which uses information about viewing conditions to estimate the subjective appearance of a coloured patch from colorimetric measurements of that patch and its surround. [Derived from ISO 12231]

NOTE A single-stimulus appearance model cannot be expected to deal completely with the effect of changing viewing conditions in an image because the combined effect of macroscopic viewing conditions and other colours in the image could result in the appearance of any colour in the image changing in a way that is not predictable by the single stimulus model, since it is not keeping track of the other colours.

**spectral product**

product of the spectral power of the incident flux and the spectral response of the receiver, wavelength by wavelength. [ISO 13655]

**spectral response (of the receiver)**

product of the spectral sensitivity of the photodetector and the transmittance of the optical elements associated with it. [ISO 13655]

**spectrally non-selective (or spectrally neutral)**

exhibiting reflective or transmissive characteristics which are constant over the wavelength range of interest. [ISO 12231]

### **spectrocolorimeter**

colorimeter which achieves the measurement values by calculation from the spectral data. [Derived from ISO 12647-1]

### **transmission densitometer**

device which measures transmittance density. [ISO 12647-1]

### **transmission density (or transmittance (optical) density)**

logarithm to base ten of the reciprocal of the transmittance factor. [ISO 5-2 and CIE Publication 17.4, 845-04-66]

### **transmittance factor ( $T_r$ )**

ratio of the luminous flux transmitted through an aperture covered by a specimen to the luminous flux through the aperture without the specimen in place. [ISO 5-2]

Editor's note: In obtaining the transmittance factor the value obtained will depend on the measurement geometry used, including the nature of the measurement aperture. Thus the measurement made may be the diffuse transmittance factor, the regular transmittance factor, or some combination of them both. However, it is common in densitometry and colorimetry to measure the diffuse transmittance factor, relative to the perfect transmitting diffuser as the reference.

### **tristimulus colorimeter**

colorimeter which achieves the measurement values by the analogue integration of the spectral product of object reflectance or transmittance factor, illuminant and filters which are defined by standard illuminant and the standard observer functions. [Derived from ISO 12647-1]

### **tristimulus value**

amounts of the three reference colour stimuli, in a given trichromatic system, required to match the colour of the stimulus considered. [CIE Publication 17.4, 845-03-22].

## ***Colour Imaging***

### **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. [ISO 12231]

NOTE 1 The adopted white may vary within a scene.

NOTE 2 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 gray or coloured.

### **aliasing**

output image artefacts that occur in a sampled imaging system for input images having significant energy at frequencies higher than the Nyquist frequency of the system. [ISO 12231]

NOTE These artefacts usually manifest themselves as moiré patterns in repetitive image features or as

jagged stair-stepping at edge transitions.

### **aligned**

a data element is aligned with respect to a data type if the address of the data element is an integral multiple of the number of bytes in the data type. [ICC.1]

### **Application Programming Interface (API)**

high-level functional description of a software interface. [ISO 12231]

NOTE An API is typically language dependent

### **ASCII text string**

sequence of bytes, each containing a graphic character from ISO/IEC 646, the last character in the string being a NULL (character 0/0). [ICC.1]

### **big-endian**

addressing the bytes within a 16, 32 or 64-bit value from the most significant to the least significant, as the byte address increases. [ICC.1]

### **bit position**

bits are numbered such that bit 0 is the least significant bit. [ICC.1]

### **byte**

8-bit unsigned binary integer. [ICC.1]

### **byte offset**

number of bytes from the beginning of a field. [ICC.1]

### **Charge Coupled Device (CCD)**

type of silicon integrated circuit used to convert light into an electronic signal. [ISO 12231]

### **check sum**

sum of the digits in a file that can be used to check if a file has been transferred properly. [ISO 12640-3]

NOTE Often, only the least significant bits are summed.

### **colour component transfer function**

single variable, monotonic mathematical function applied individually to one or more colour channels of a colour space. [ISO 12231]

NOTE 1 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 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.

### **colour encoding**

a generic term for a quantized digital encoding of a colour space, encompassing both colour space encodings and colour image encodings. [ISO 22028-1]

## **colour image encoding**

digital encoding of the colour values for a digital image. [Derived from ISO 12231]

NOTE 1 According to ISO 12231 such encoding must include the specification of a colour space encoding (which specifies the encoding method and value range), together with any information necessary to properly interpret the colour values such as the image state, the intended image viewing environment and the reference medium. In some cases the intended image viewing environment will be explicitly defined for the colour image encoding. In other cases, the intended image viewing environment may be specified on an image-by-image basis using metadata associated with the digital image. This requirement is essential to properly interpret the colour of the data.

NOTE 2 Some colour image encodings will indicate particular reference medium characteristics, such as a reflection print with a specified density range. In other cases the reference medium will be not applicable, such as with a scene-referred encoding, or will be specified using image metadata.

NOTE 3 Colour image encodings are not limited to pictorial digital images that originate from an original scene, but are also applicable to digital images with content such as text, line art, vector graphics and other forms of original artwork.

## **colour space encoding**

digital encoding of a colour space, including the specification of a digital encoding method, and a colour space value range. [ISO 12231]

NOTE Multiple colour space encodings may be defined based on a single colour space where the different colour space encodings have different digital encoding methods and/or colour space value ranges. (For example, 8-bit sRGB and 10-bit e-sRGB are different colour space encodings based on a particular RGB colour space.)

## **colour sequence**

order in which the colours are stored in a data file. [ISO 12640-3].

## **colour value**

numeric values associated with each of the pixels of an image, or each point of a colour space. [Derived from ISO 12640-3]

## **data range**

range of values for a given variable in between a minimal and maximal value. [Derived from ISO 12640-3]

## **digital imaging system**

system that records and/or produces images using digital data. [ISO 12231]

## **digital output level**

numerical value assigned to a particular output level, also known as the digital code value. [ISO 12231]

## **Electro-Optical Conversion Function (EOCF)**

relationship between the digital code values provided to an output device and the equivalent neutral densities produced by the device. [ISO 12231]

## **EPS**

Encapsulated PostScript as defined by Adobe *Technical Note #5002*. [ISO 15930]

### **fixed point**

method of encoding a real number into binary by putting an implied binary point at a fixed bit position. [ICC.1]

NOTE Many of the tag types defined in this International Standard contain fixed point numbers. Several references can be found (MetaFonts, etc.) illustrating the preferability of fixed point representation to pure floating point representation in very structured circumstances.

### **flare**

light falling on an image, in an imaging system, which does not emanate from the subject point. [ISO 12231]

NOTE Veiling glare is also sometimes referred to as flare.

### **gamma correction**

signal processing operation that changes the relative signal levels in order to adjust the image tone reproduction. [Derived from ISO 12231]

NOTE 1 Gamma correction is normally used in the context of displays, and is performed in part to correct for the nonlinear light-output versus signal input characteristic of the display. The relationship between the light input level and the output signal level, called the OECF, provides the gamma correction curve shape for an image capture device. The relationship between the output signal level and equivalent neutral density produced, called the EOCF, provides the gamma correction curve shape for an output device.

NOTE 2 The gamma correction is usually an algorithm, lookup table, or circuit which operates separately on each colour component of an image.

### **hardcopy**

representation of an image on a substrate which is self-sustaining and reasonably permanent. [ISO 12231]

### **hexadecimal**

number system used to represent the value of a 4-bit binary word. [ICC.1]

NOTE The notation used to represent hexadecimal numbers in this International Standard is xxh.

### **image capture device**

device for converting a scene or a fixed image such as a print, film, or transparency, to digital image data. [ISO 12231]

### **image data format**

structure and content which specifies how the data is logically organised on a given storage medium. [ISO 12231]

### **image noise**

unwanted variations in an image. [ISO 12231]

### **image output device**

device that can render a digital image to hardcopy or softcopy media. [ISO 12231]

### **image state**

attribute of a colour image encoding indicating the type of image data to which the encoded image colour values are referred. [ISO 12231]

NOTE The image states defined in this glossary are scene-referred, original-referred and output-referred.

### **metadata**

data associated with a digital image aside from the pixel values that comprise the digital image. [ISO 12231]

NOTE Metadata is typically stored as tags in the digital image file

### **Most Significant Nibble (MSN)**

most-significant four bits of the most-significant byte. [ISO 12231]

### **NULL**

character coded in position 0/0 of ISO/IEC 646. [ICC.1]

### **Nyquist limit**

spatial frequency equal to 0,5 times the inverse of the sampling period. [ISO 12231]

NOTE Energy at input spatial frequencies above the Nyquist limit will alias to a spatial frequency below the Nyquist limit in the output image. The Nyquist limit may be different in the two orthogonal directions.

### **Opto-Electronic Conversion Function (OECF)**

relationship between the log of the input levels and the corresponding digital output levels for an optoelectronic digital image capture system. [ISO 12231]

NOTE If the input log exposure points are very finely spaced and the output noise is small compared to the quantisation interval, the OECF may have a step-like character. Such behavior is an artifact of the quantization process and should be removed by using an appropriate smoothing algorithm or by fitting a smooth curve to the data.

### **orientation**

specifies the origin and direction of the first line of data, with respect to the image content as viewed by the end user. [Derived from ISO 12640-3]

### **original-referred image data**

image data which represents the colour-space coordinates of the elements of a two-dimensional hardcopy or softcopy image, typically produced by scanning artwork, photographic transparencies or prints, or photomechanical or other reproductions. [ISO 12231]

NOTE 1 Original-referred image data is related to the colour-space coordinates of the original as measured according to ISO 13655, and does not include any additional veiling glare or other flare.

NOTE 2 The characteristic of original-referred image data that most generally distinguishes it from scene-referred image data is that it is referred to a two-dimensional surface, and the illumination incident on the two dimensional surface is assumed to be uniform (or the image data corrected for any non-uniformity in the illumination).

NOTE 3 There are classes of originals that produce original-referred image data with different characteristics. Examples include various types of artwork, photographic prints, photographic transparencies, emissive displays, etc. When selecting a colour re-rendering algorithm, it is usually necessary to know the class of the original in order to determine the appropriate colour re-rendering to be applied. For example, a colorimetric intent is generally applied to artwork, while different perceptual algorithms are applied to produce photographic prints from transparencies, or newsprint reproductions from photographic prints. In some cases the assumed viewing conditions are also different between the original classes, such as between photographic prints and transparencies, and will usually be considered in well-designed systems.

NOTE 4 In a few cases, it may be desirable to introduce slight colorimetric errors in the production of

original-referred image data, for example to make the gamut of the original more closely fit the colour space, or because of the way the image data was captured (such as a Status A densitometry based scanner).

### **output-referred image data**

image data which 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. [ISO 12231]

NOTE 1 The output referred image data is 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 2 Output-referred image data may become the starting point for a subsequent reproduction process. For example, sRGB output-referred image data is frequently considered to be the starting point for the colour re-rendering performed by a printer designed to receive sRGB image data.

### **PDF (Portable Document Format)**

file format defined in the *Adobe Portable Document Format*. [ISO 15930]

### **pixel**

smallest discrete picture element in a digital image file. [ISO 12640-3]

### **pixel interleaving**

image data organized such that the colour values for one pixel are followed by the same sequence of colour values for the next pixel. [Derived from ISO 12640-3]

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

### **reader**

application, system or subsystem that accepts a file as its input and performs a level of processing on that file that, at the minimum, accepts or rejects the file based on predetermined criteria and, if accepted, passes the file to the next stage of processing. [ISO 12639]

### **resolution**

measure of the ability of a digital image capture system, or a component of a digital image capture system, to depict spatial picture detail. [ISO 12231]

NOTE Resolution measurement metrics include resolving power, visual resolution, limiting resolution, SFR, MTF and OTF.

### **sample spacing**

physical distance between sampling points or sampling lines. [ISO 12231]

NOTE The sample spacing may be different in the two orthogonal sampling directions.

### **sampled imaging system**

imaging system or device which generates an image signal by sampling an image at an array of discrete points, or along a set of discrete lines, rather than a continuum of points. [ISO 12231]

NOTE The sampling at each point is done using a finite size sampling aperture or area.

## **sampling frequency**

reciprocal of the sample spacing. [ISO 12231]

NOTE The sampling frequency is expressed in samples per unit distance.

## **scanner**

electronic device that converts a fixed image, such as a print or film transparency, into an electronic signal. [ISO 12231]

## **scene-referred image data**

image data which represents estimates of the colour-space coordinates of the elements of a scene. [ISO 12231]

NOTE 1 Scene-referred image data can be determined from raw 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 2 Scene-referred image data typically represents 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 3 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. ISO 17321-1 specifies a DSC/SMI (DSC Sensitivity Metamerism Index), which can be used to estimate the amount of inaccuracy resulting from capture device metamerism.

NOTE 4 The transformation from raw DSC image data 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 transformation 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 5 Standard methods for the calculation of scene-referred image data from raw DSC image data will be specified in ISO 17321-2.

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

## **(ICC registered) signature**

alphanumeric 4-byte value, registered with the ICC. [Derived from ICC.1]

## **softcopy**

representation of an image produced using a device capable of directly representing different digital images in succession and in a non-permanent form; the most common example being a display. [Derived from ISO 12231]

## **TIFF**

a tagged image file format as defined by revision 6.0 of *TIFF*. [ISO 15930]

## **veiling flare**

relatively uniform but unwanted irradiation in the image plane of an optical system, caused

by the scattering and reflection of a proportion of the radiation which enters the system through its normal entrance aperture. [ISO 12231]

NOTE 1 The veiling flare radiation may be from inside or outside the field of view of the system.

NOTE 2 Light leaks in an optical system housing can cause additional unwanted irradiation of the image plane. This irradiation may resemble veiling flare.

### **veiling glare**

light, reflected from an imaging medium, that has not been modulated by the means used to produce the image. [ISO 12231]

NOTE 1 Veiling glare lightens and reduces the contrast of the darker parts of an image.

NOTE 2 In CIE 122, the veiling glare of a CRT display is referred to as ambient flare.

### **viewing flare**

veiling glare that is observed in a viewing environment but not accounted for in radiometric measurements made using a prescribed measurement geometry. [ISO 12231]

NOTE The viewing flare is expressed as a percentage of the luminance of the adapted white.

### **writer**

application, system or subsystem that generates a file based on predetermined criteria and prepares the file for output. [ISO 12639]

## ***Digital Photography***

### **raw Digital Still Camera (DSC) image data:**

image data produced by, or internal to, a DSC that has not been processed, except for A/D conversion and the following optional steps: linearisation, dark current/frame subtraction, shading & sensitivity (flat field) correction, flare removal, white balancing (e.g. so the adopted white produces equal RGB values or no chrominance), missing colour pixel reconstruction (without colour transformations). [ISO 12231]

### **depth of field**

difference between the maximum and minimum distances from a camera lens's front nodal point to objects in a scene that can be captured in acceptably sharp focus. [ISO 12231]

### **Exchangeable image file format (Exif)**

Digital Still Camera Image File Format Standard of the Japan Electronic Industry Development Association (JEIDA). [ISO 12231]

NOTE - The JPEG version of Exif provides a compressed file format for digital cameras in which the images are compressed using the baseline JPEG standard described in ISO/IEC 10918-1, and metadata and thumbnail images are stored using TIFF tags within an application segment at the beginning of the file.

### **photography**

acquisition, processing or reproduction of optically-formed images using chemical or electronic technologies. [ISO 12231]

### **scene**

spectral radiances of a view of the natural world as measured from a specified vantage point in space and at a specified time. [ISO 12231]

NOTE A scene may represent an actual view of the natural world or a computer-generated simulation of such a view.

### **scene luminance ratio**

ratio of the highest (highlight) luminance value to the lowest (shadow) luminance value in a scene. [ISO 12231]

### **white balance**

adjustment of electronic still picture colour channel gains or image processing so that radiation with relative spectral power distribution equal to that of the scene illumination source is rendered as a visual neutral. [ISO 12231]

## ***Colour Pre-press and Printing***

### **axis of a (half-tone) screen**

one of the two directions in which the half-tone pattern shows the highest number of image elements, such as dots or lines, per length. [ISO 12647-1]

### **bleed**

additional printing area outside the nominal printing area necessary for the allowance of mechanical tolerance in the trimming process. [ISO 15930]

NOTE The bleed area includes the area that may be printed but does not include printers' marks of any kind.

### **characterized printing condition**

printing condition (offset, newsprinting, publication gravure, flexographic, direct, etc.) for which process control aims are defined and for which the relationship between printing tone values (usually CMYK) and the colorimetry of the printed image is documented. [Derived from ISO 15930]

NOTE 1 The relationship between printing tone values and the colorimetry of the printed image is commonly referred to as characterization.

NOTE 2 It is generally preferred that the process control aims of the printing condition and the associated characterization data be made publicly available via the accredited standards process or industry trade associations.

NOTE 3 Characterisation data for many standard printing conditions may be found in the characterization registry on the ICC web site.

### **colour separation film**

one of a set of black-and-white half-tone films for process printing that pertains to one process colour. [ISO 12647-1]

NOTE There are usually four colour separation films in a set.

### **control patch**

area produced for control or measurement purposes. [ISO 12647-1]

### **control strip**

one-dimensional array of control patches. [ISO 12647-1]

### **deviation tolerance**

permissible difference between the OK print from a production run and the reference value. [ISO 12647-1]

### **doubling/slur patch**

control patch for the assessment of the true rolling condition. [ISO 13655]

### **engraving pitch (*P*)**

cell spacing on a gravure cylinder, evaluated from the following formula:

$$P = \sqrt{a \times b}$$

where

*a* is the distance between the same points on two adjacent cells in the printing direction;

*b* is the distance between adjacent circumferential tracks of the engraving stylus. [ISO 12647-4]

### **four-colour continuous forms printing**

offset process performed on small width web-fed presses for use with personalized mailings [ISO 12647-2]

### **grey balance**

set of tone values for cyan, magenta and yellow on the colour separation films, or in a data file, that appears as an achromatic colour under specified viewing conditions when printed under specified printing conditions. [Derived from ISO 12647-1]

NOTE Two practical procedures are often used to define such a grey: "A colour having the same CIELAB *a*\* and *b*\* values as the print substrate" and "a colour that has the same CIELAB *a*\* and *b*\* values as a half-tone tint of similar *L*\* value printed with black ink". Both usually produce different values, and both may differ somewhat from a perceived grey seen in isolation.

### **Grey Component Replacement (GCR)**

replacement of some, or all, of cyan, magenta and yellow printing inks by black ink, such that the colour is maintained. (*See Under Colour Removal UCR*)

### **half-tone**

Image composed of dots which can vary in screen ruling (number per centimetre), size, shape, or density, thereby producing tonal gradations. [ISO 12637-1]

### **half-tone film**

film for use with a half-tone printing process showing image elements such as dots or lines. [ISO 12647-1]

### **image orientation (on film)**

right-reading (opposite: wrong-reading) if text appears as it is intended to be read and images are in the orientation intended for viewing by the end user. [ISO 12647-1]

NOTE 1 The film emulsion orientation requires specification as well: state "emulsion up" or "emulsion down". "Emulsion up" is usually assumed if there is no film emulsion orientation statement.

NOTE 2 A typical reference is "wrong-reading emulsion up" which is equivalent to "right-reading emulsion down".

### **improved newsprint**

paper with, compared to ordinary newsprint, a higher smoothness, a higher brightness and a filler content up to 20%. [ISO 12647-4]

### **ink trap**

For an overprint, a relative measure for the average amount of colorant per unit area of the second-down colorant layer that is deposited on to the first-down colorant layer. To be expressed as a percentage. [ISO 13655]

NOTE 1 Not to be confused with trap employed in colour separation to attenuate mis-register effects.

NOTE 2 Apparent ink trap is measured optically; gravimetric ink trap by weight.

### **mid-tone spread (S)**

quantity defined by the following equation:

$$S = \max\{(Ac - Ac0), (Am - Am0), (Ay - Ay0)\} - \min\{(Ac - Ac0), (Am - Am0), (Ay - Ay0)\}$$

where:

Ac is the measured tone value of the cyan process colour image

Ac0 is the specified tone value of the cyan process colour image

Am is the measured tone value of the magenta process colour image

Am0 is the specified tone value of the magenta process colour image

Ay is the measured tone value of the yellow process colour image

Ay0 is the specified tone value of the yellow process colour image

EXAMPLE Calculation of the mid-tone spread

measured values (c,m,y) = (22,17,20); specified values (c,m,y) = (20,20,18)

$\max\{(22-20), (17-20), (20-18)\} = 2$ ;  $\min\{(22-20), (17-20), (20-18)\} = -3$

$S = \{\max - \min\} = 5$

[ISO 12647-1]

### **moiré pattern**

unwanted periodic structure produced by interference between two or more two-dimensional periodic structures. [ISO 12647-1]

### **negative-acting (offset printing) plate**

offset printing plate for use with negative polarity film. [ISO 12647-2]

### **negative film polarity**

property of a colour separation film, whose clear and solid areas on the film correspond to solid and unprinted areas on the print, respectively. [ISO 12647-1]

### **non-periodic (half-tone) screen**

half-tone screen without a regular half-tone dot pattern. [Derived from ISO 12647-1]

NOTE Also known as a stochastic or frequency modulated (half-tone) screen.

**off-press proof print**

print produced by a method other than press printing whose purpose is to show the results of the colour separation process in a way that closely simulates the results on a production press. [ISO 12647-1]

NOTE Also known as artificial or pre-press proof.

**OK print; OK sheet**

during production printing the production print singled out as reference for the remaining production run. [ISO 12647-1]

**on-press proof print**

print produced by press printing (production or proof press) whose purpose is to show the results of the colour separation process in a way that closely simulates the results on a production press. [ISO 12647-1]

**overprint**

condition where two or more layers of colorant, usually ink, are printed on top of another. [ISO 13655]

**positive-acting (offset printing) plate**

offset printing plate for use with positive polarity film. [Derived from ISO 12647-2 – negative-acting plate)

**positive film polarity**

property of a colour separation film, whose clear and solid areas correspond to unprinted and solid areas on the print, respectively. [ISO 12647-1]

**primary colours**

colours of individual prints produced from yellow, magenta and cyan inks. [Derived from ISO 2846-1]

NOTE If the prints are produced as specified in the appropriate part of ISO 2846, and conform to the colorimetric characteristics specified in that specification, the colours are standard primary colours.

**principal axis (of a halftone screen)**

axis of a screen that coincides with the direction of the longest diameter of an oblong-shaped (e.g. elliptical or diamond-shaped) half-tone dot. [ISO 12647-1]

NOTE Circular and square shaped half-tone dots do not have a principal axis.

**printing condition**

set of printing details which fully describe the conditions associated with a specific printed output, usually associated with characterization data measured from an ISO 12642 or similar target. [ISO 12647-1]

NOTE Such parameters usually include (as a minimum) printing process, print substrate type, printing ink, screen type and screen frequency, manner used to produce the printing forme, and surface finish.

**printing forme**

tool whose surface is prepared such that some parts transfer printing ink whereas other parts do not. [ISO 12647-1]

**print substrate**

material bearing the printed image. [ISO 12647-1]

**printing tone value**

data value corresponding to the relative area of a printing surface that is intended to transfer ink to the substrate being printed. [ISO 15930]

**process colour solid**

printed area of a process colour that corresponds to 100% tone value, or the maximum cell volume identified for the combination of gravure engraving parameters. [Derived from ISO 12647-4]

**process colours (for four-colour printing)**

yellow, magenta, cyan and black. [ISO 12647-1]

**reference direction (of an image)**

horizontal direction as viewed by the end user. [ISO 12647-1]

**screen angle**

with oblong-shaped half-tone dots the angle which the principal axis of the screen makes with the reference direction, with circular and square dot shapes the smallest angle which an axis of the screen makes with the reference direction. [ISO 12647-1]

**screen frequency, screen ruling**

number of image elements, such as dots or lines, per unit of length in the direction which produces the highest value. [ISO 12647-1]

**screen width**

reciprocal of screen ruling. [ISO 12647-1]

**secondary (ink) colours**

colours obtained by overprinting pairs of the three chromatic inks. [Derived from ISO 2846-1]

**solid**

Image of uniform coloration intensity with no half-tone structure. [ISO 13656]

**standard (process) ink**

ink, intended for four-colour printing, which when printed on the reference substrate and within the applicable range of ink film thicknesses complies to the colorimetric and transparency specifications of the relevant part of ISO 2846. [Derived from ISO 2846-1]

### **standard (process) ink set**

complete set of standard (process) inks comprising yellow, magenta, cyan and black.  
[Derived from ISO 2846-1]

### **surface finishing**

process by which a print is either covered by varnish (lacquer) or laminated with a transparent polymeric film. [ISO 12647-1]

### **spot colour**

single colorant, identified by name, whose printing tone-values are specified independently from the colour values specified in a colour coordinate system. [ICC.1 and ISO 15930]

### **tone value (in a data file) (A)**

proportional printing value encoded in a data file and interpreted as defined in the file format specification.

NOTE Most files store these data as 8-bit integer values, i.e., 0 to 255. The tone value of a pixel is typically computed from the equation:

$$A\% = 100 \times \left( \frac{V_p - V_0}{V_{100} - V_0} \right)$$

where

$V_p$  is the integer value of the pixel;

$V_0$  is the integer value corresponding to a tone value of 0 %;

$V_{100}$  is the integer value corresponding to a tone value of 100 %.

[ISO 12647-1]

### **tone value; dot area (on a half-tone film of positive polarity) (A)**

percentage calculated from:

$$A\% = 100 \times \left( \frac{1 - 10^{-(D_t - D_0)}}{1 - 10^{-(D_s - D_0)}} \right)$$

where

$D_0$  is the transmittance density of the clear half-tone film;

$D_s$  is the transmittance density of the solid;

$D_t$  is the transmittance density of the half-tone.

[Derived from ISO 12647-1]

NOTE 1 Formerly known as the film printing dot area.

NOTE 2 The above equation is often known as the Murray-Davies equation.

### **tone value; dot area (on a half-tone film of negative polarity) (A)**

percentage calculated from:

$$A\% = 100 \times \left( 1 - \frac{1 - 10^{-(D_t - D_0)}}{1 - 10^{-(D_s - D_0)}} \right)$$

where

$D_0$  is the transmittance density of the clear half-tone film;

$D_s$  is the transmittance density of the solid;

$D_t$  is the transmittance density of the half-tone.

[ISO 12647-1]

NOTE Formerly known as the film printing dot area.

### **tone value; dot area (on a print) (A)**

percentage of the surface which appears to be covered by colorant of a single colour (if light scattering in the print substrate and other optical phenomena are ignored), calculated from:

$$A\% = 100 \times \left( \frac{1 - 10^{-(D_t - D_0)}}{1 - 10^{-(D_s - D_0)}} \right)$$

where

$D_0$  is the reflectance factor density of the unprinted print substrate, or the non-printing parts of the printing forme;

$D_s$  is the reflectance factor density of the solid;

$D_t$  is the reflectance factor density of the half-tone.

[Derived from ISO 12647-1]

NOTE 1 Formerly also known as apparent, equivalent or total dot area.

NOTE 2 The synonym dot area may be applied only to half-tones produced by dot patterns.

NOTE 3 This definition may be used to provide an approximation of the tone value on certain printing formes.

NOTE 4 The above equation is often known as the Murray-Davies equation.

### **tone value increase; dot gain**

difference between a tone value on the print and the tone value on the half-tone film or in the digital data file. [ISO 12647-1]

NOTE The synonym dot gain may be applied only to half-tones produced by dot patterns.

EXAMPLE 1 The tone value of the control strip patch on the print is 55 %, that on the film is 40 %. The tone value increase is 15 %.

EXAMPLE 2 The tone value of a flat tint produced by an application program is set to be 75 %, the corresponding tint on the print is measured at 92 %. The tone value increase is 17 %.

### **tone value sum**

sum of the tone values, at a given image spot, of all four colours. [Derived from ISO 12647-1]

NOTE 1 Sometimes known as the total dot area (TDA) or total area coverage (TAC).

NOTE 2 For most sets of colour separation films the maximum of the tone value sum occurs at the position of the darkest achromatic tone of the image.

NOTE 3 The tone value sum may be determined from the colour separation films or from the digital file.

### **transparency (of an ink film)**

ability of an ink film to transmit and absorb light without scattering. [Derived from ISO 2846-1]

### **transparency measurement values (of an ink film)**

the reciprocal of the slope of the regression line between ink film thickness and colour difference for overprints of chromatic inks over black. [Derived from ISO 2846-1]

## **trapping**

modification of boundaries of colour areas to account for dimensional variations in the printing process by overprinting in selected colours at the boundaries between colours that might inadvertently be left uncoloured due to normal variations of printing press registration. [ISO 15930]

NOTE This is alternately referred to as chokes and spreads or grips and is not to be confused with the term "ink trapping."

## **Under Colour Removal (UCR)**

replacement of cyan, magenta and yellow inks by black ink, in achromatic and near-achromatic colours only, such that the colour is maintained.

NOTE This can be thought of as a special case of GCR.

## **variation tolerance**

permissible difference between the OK print and that of a sample print taken at random from the production. [ISO 12647-1]

## ***Psychophysics***

### **attribute Just Noticeable Difference (attribute JND)**

a measure of the detectability of appearance variations, corresponding to a stimulus difference that would lead to a 75:25 proportion of responses in a paired comparison task in which univariate stimuli pairs were assessed in terms of a single attribute identified in the instructions. [ISO 12231]

NOTE 1 As an example, a paired comparison identifying the sharper of two stimuli that differed only in their generating system modulation transfer function (MTF), would yield results in terms of sharpness attribute JNDs. If the MTF curves differed monotonically and did not cross, the outcome of the paired comparison would depend primarily upon the observers' ability to detect changes in the appearance of the stimuli as a function of MTF variations, with little or no value judgement required of the observers. If a given stimulus difference were genuinely detected by one-half of observers, then on average a 75:25 proportion of responses would result, because those observers detecting the difference would all identify the same sample as being sharper, whereas those not detecting the difference would be forced to guess, and would therefore be equally likely to choose either sample. The relationship between paired comparison proportions and stimulus differences is discussed in greater detail in Annex A of ISO 20462-1.

NOTE 2 If observers are instead asked to choose which of a pair of stimuli is higher in overall image quality, and if the stimuli in aggregate are multivariate, such that the observer must make value judgements of the importance of a number of attributes, rather than focussing on one aspect of image appearance, it is observed experimentally that larger objective stimulus differences (for example, MTF changes) are required to obtain a 75:25 proportion of responses, which in this case corresponds to a quality JND. In the cases of sharpness and noisiness, approximately twice as large an objective stimulus difference is required to produce one quality JND compared to one attribute JND. Because an attribute change cannot affect quality unless it is detectable, the number of attribute JNDs will always place an upper bound on the number of quality JNDs.

### **magnitude estimation method**

a psychophysical method involving the assignment of a numerical value to each test stimulus that is proportional to the attribute under test, such as an attribute of image quality. [Derived from ISO 12231]

NOTE Typically, a reference stimulus with an assigned numerical value is present to anchor the rating scale.

NOTE The numerical scale resulting from a magnitude estimation experiment is usually assumed to constitute a ratio scale, which, ideally, is a scale in which a constant percentage change in value

corresponds with one JND. In practice, modest deviations from this behaviour occur, complicating the transformation of the rating scale into units of JNDs without inclusion of unidentified reference stimuli (having known quality) among the test stimuli.

### **paired comparison method**

a psychophysical method involving the choice of which of two simultaneously presented stimuli exhibits greater or lesser image quality or an attribute thereof, in accordance with a set of instructions given to the observer. [ISO 12231]

NOTE Two limitations of the paired comparison method are as follows. (1) If all possible stimulus comparisons are done, as is usually the case, a large number of assessments are required for even modest numbers of experimental stimulus levels (if  $N$  levels are to be studied,  $N(N-1)/2$  paired comparisons are needed). (2) If a stimulus difference exceeds approximately 1.5 JNDs, the magnitude of the stimulus difference cannot be directly estimated reliably because the response saturates as the proportions approach unanimity. However, if a series of stimuli having no large gaps are assessed, the differences between more widely separated stimuli may be deduced indirectly by summing smaller, reliably determined (unsaturated) stimulus differences. The various methods for transformation of paired comparison data to an interval scale (a scale linearly related to JNDs) perform statistically optimised procedures for inferring the stimulus differences using all the available data in a weighted estimate.

### **psychophysical experimental methods**

experimental technique for subjective evaluation of image quality or attributes thereof, from which stimulus differences in units of JNDs may be estimated. [ISO 12231]

### **quality Just Noticeable Difference (quality JND)**

a measure of the significance or importance of quality variations, corresponding to a stimulus difference that would lead to a 75:25 proportion of responses in a paired comparison task in which multivariate stimuli pairs were assessed in terms of overall image quality. [ISO 12231]

NOTE The attribute JND is a measure of detectability of appearance changes, whereas the quality JND is a measure of significance or importance of stimulus differences in terms of their impact on quality. An attribute JND is a useful unit for predicting how observers would react to an advertisement showing images carefully matched in all respects but one, and drawing the attention of the observer to the attribute varying. In contrast, a quality JND is useful for predicting how observers would perceive overall quality as a function of one or more stimulus variations, and so is a more useful quantity in optimizing imaging system design, where different attributes must be balanced against one another. The overall quality of an image may be predicted from a knowledge of the impact of each attribute in isolation, expressed in terms of quality JNDs, whereas the same is not true of attribute JNDs. Therefore, it is often highly desirable to obtain results expressed in quality JNDs, even if the stimuli being assessed are univariate in nature. This can be accomplished if test stimuli are rated against a series of appropriately calibrated reference stimuli, as in the quality ruler method.

### **quality ruler method**

a psychophysical method described in ISO 20462-3, which involves quality or attribute assessment of a test stimulus against a series of ordered, univariate reference stimuli that differ by known numbers of JNDs. [ISO 12231]

### **rank ordering method**

a psychophysical method involving the arrangement by an observer of a series of stimuli in order of increasing or decreasing image quality or an attribute thereof, in accordance with the set of instructions provided. [ISO 12231]

### **reference stimulus**

an image provided to the observer for the purpose of anchoring or calibrating the perceptual assessments of test stimuli in such a manner that the given ratings may be

converted to JND units. [ISO 12231]

### **Standard Quality Scale (SQS)**

a fixed numerical scale of quality defined in ISO 20462-3 and having the following properties: (1) the numerical scale is anchored against physical standards; (2) a one unit increase in scale value corresponds to an improvement of one JND of quality; and (3) a value of zero corresponds to an image having so little information content that the nature of the subject of the image is difficult to identify. [ISO 12231]

### **stimulus**

an image presented or provided to the observer either for the purpose of anchoring a perceptual assessment (a reference stimulus) or for the purpose of subjective evaluation (a test stimulus). [ISO 12231]

### **triplet comparison method**

psychophysical method, defined in ISO 20462-2, which involves the simultaneous rank ordering of three test stimuli with respect to image quality or an attribute thereof, in accordance with a set of instructions given to the observer. [Derived from ISO 12231]