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Image technology colour management — Architecture, profile format and data structure —

Part 1: Based on ICC.1:2022

Gestion de couleur en technologie d'image — Architecture, format de profil et structure de données —

Partie 1: Sur la base de l'ICC.1:2022

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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 document 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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 15076-1:2010), which has been technically revised.

The main changes are as follows:

— cicpTag has been added to enable HDR metadata to be carried in the profile;

— metadataTag and dictType have been added to enable flexible definition of additional metadata;

— it has been clarified that PCSXYZ values can be negative;

— Tag tables are now required to define a contiguous sequence of unique tag elements, with no gaps;

— parametricCurveType functions in Table 69 have been corrected;

— informative Annex B content on embedding profiles has been replaced with a reference to an ICC Technical Note;

— informative Annex E on chromatic adaptation has been updated;

— the Bibliography and normative references have been updated.

Profiles created in conformance with this document are identified as Version 4.4.0.0 profiles.

A list of all parts in the ISO 15076 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

0.1 General

This document specifies the profile format defined by the International Color Consortium® (ICC). The intent of this format is to provide a cross-platform profile format for the creation and interpretation of colour data. Such profiles can be used to translate between different colour encodings, and to transform colour data created using one device into another device's native colour encoding. The acceptance of this format by application and operating system vendors allows end users to transparently move profiles, and images with embedded profiles, between different systems. For example, this allows a printer manufacturer to create a single profile for multiple applications and operating systems.

It is assumed that the reader of this document has a good understanding of colour science and imaging, such as familiarity with CIE, ISO and IEC colour standards, general knowledge of device measurement and characterization, and familiarity with at least one operating system level colour management system.

0.2 International Color Consortium

The International Color Consortium was formed with the primary intent of developing and administering a colour profile format standard, and for the registration of the associated tag signatures and descriptions. The founding members of this consortium can be found on the ICC website[1)].

0.2.1 ICC profile versions

The initial version of the profile specification developed by the ICC has undergone various revisions, and it was agreed by the ICC that its revision 4.2 first be proposed as an International Standard. It is that revision which formed the basis of the first edition, ISO 15076-1:2005.[28] The second edition, ISO 15076-1:2010,[29] was based on ICC revision 4.3, which is fully backward compatible with 4.2. This document is based on ICC.1:2022 (the ICC revision 4.4 of ICC.1), and is fully backward compatible with earlier versions. All the technical specifications contained in the previous edition (ISO 15076-1:2010) are also given in this document, and new specifications exclusive to this document are identified in the Foreword. Informative material has also been updated and clarified.

The ICC specification is widely used and is referred to in other ISO standards. Table 1 is provided to assist users to identify the main technical differences between versions.

1) Available from https://color.org/iccmembers.xalter

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Table 1 — ICC and ISO versions of the ICC profile specification

ISO version	ICC version	Profile version	Main technical changes relative to previous version
ISO 15076-1:2005	ICC.1:2005	4.2	N/A
ISO 15076-1:2010	ICC.1:2010	4.3	Addition of — perceptual intent reference medium colour gamut — new technology signatures — a floating-point device encoding range — a colorimetric intent image state tag — a profile sequence identifier tag Deletion of the mediaBlackPointTag PCSXYZ no longer limited to the PCS illuminant
ISO 15076-1:2024	ICC.1:2024	4.4	Addition of — cicpTag to enable HDR metadata to be carried in the profile — metadataTag and dictType added to enable flexible definition of additional metadata Clarified that PCSXYZ values can be negative Tag tables now required to define a contiguous sequence of unique tag elements, with no gaps parametricCurveType functions corrected

The ICC will continue to administer its own version of this document and, if enhancements are made to ICC.1, they will be considered for future revisions of ISO 15076-1. ICC and ISO/TC 130 will work to ensure that there are no significant differences between the ICC and ISO versions of this document.

The ICC web site (www.color.org) provides supplementary information relevant to ISO 15076-1 and ICC.1 and additional resources for developers and users. It also provides information on how to become a member of ICC.

0.3 Colour management architecture and profile connection space

The underlying architecture assumed in this document is based around a reference colour space that is unambiguously defined. The colour specification method selected was that defined by CIE which is internationally accepted. The CIE system enables a set of tristimulus values (CIEXYZ) to be specified for a coloured stimulus. These tristimulus values enable a user to determine whether colours match in appearance when viewed by a typical observer in a specific viewing environment. It follows that it is possible to define the colour appearance of a sample by these tristimulus values (or some defined transformation of them) for a specified state of viewer adaptation. The colour appearance is simply the appearance of the colour to a typical human observer, as opposed to the physical characteristics of the colour stimulus, which is not fully specified using tristimulus values.

Calculation of the CIEXYZ values for transmitting or reflecting media is achieved from the spectral sum-product of the reflectance or transmittance of the sample, the relative spectral power distribution of the illumination source used to view it and the spectral 'sensitivity' of the standard observer. However, as CIE defines two standard observers, two measurement geometries (for reflecting media) and a large number of standard illuminants, it is necessary to restrict these options in order to have a colour specification system that is not ambiguous for a particular application. For this document, the ICC has defined such a restriction, based on ISO 13655, and the resultant colour spaces are known as PCSXYZ and PCSLAB. Furthermore, the simple CIE system (whether CIEXYZ or the CIELAB values derived from them) does not accommodate the effect of surrounding stimuli to the sample being measured (which can be different for various types of media) or the illumination. Both of these affect appearance so the PCS values do not by themselves specify appearance. To overcome this problem, the PCS is used in two different ways. The first accounts only for the assumed state of chromatic adaptation of the viewer, and describes the colorimetry of actual originals and their reproductions, chromatically adapted to the PCS adopted white chromaticity, through the colorimetric

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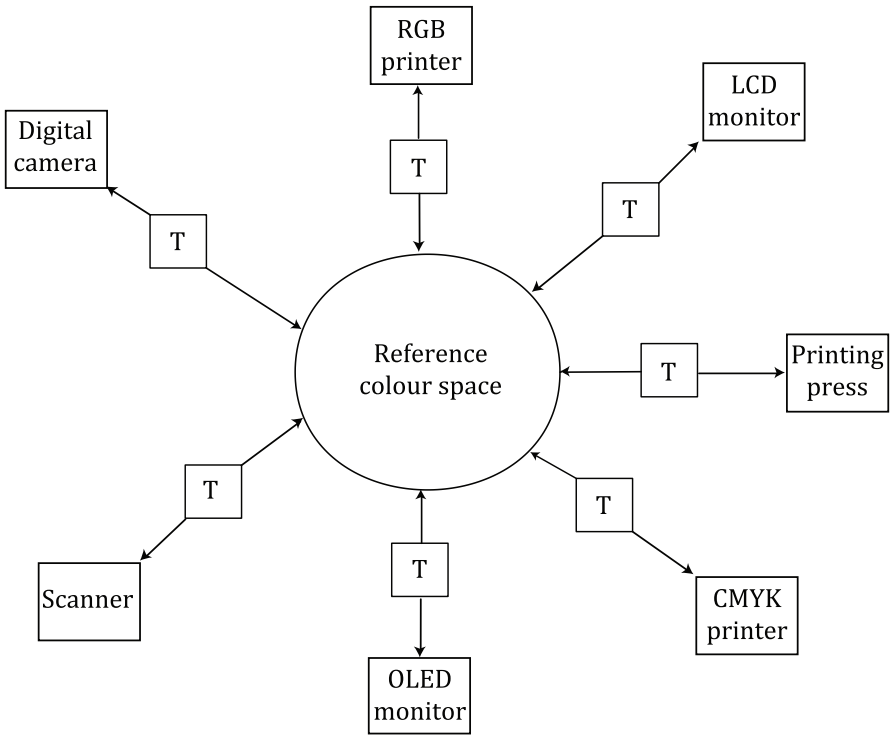
rendering intents. The second, which describes the colorimetry of an image colour rendered to a standard reference medium under a specified viewing condition, is employed for the perceptual rendering intent and optionally for the saturation rendering intent. Thus, it can incorporate corrections for different states of viewer adaptation and other desired rendering effects, as well as accommodating differences between actual colour encoding and device dynamic ranges and colour gamuts, and those of the perceptual intent reference medium. When required, the viewing conditions can be specified to allow colour appearance to be determined for the colorimetric rendering intents.

In summary, the PCS is based on CIEXYZ (or CIELAB) determined for a specific observer (CIE Standard 1931 Colorimetric Observer, often known colloquially as the 2-degree observer), relative to a specific illuminant chromaticity (that of CIE D50), and measured with a specified measurement geometry (0°:45° or 45°:0°), for reflecting media. Measurement procedures are also defined for transmitting and self-luminous media. Since the conversion from CIEXYZ to CIELAB is quite unambiguous, profile builders can use either colour space for the PCS; the colour management system is able to determine which has been used from a tag in the header.

For colorimetric renderings where the measured data were not obtained relative to a D50 adopted white chromaticity, the profile builder is expected to adapt the data to achieve this. Therefore, a mechanism for identifying the chromatic adaptation used in such situations is provided. For the perceptual rendering intent, the viewing conditions and reference medium are specified in order to provide a clear target for colour rendering and re-rendering (including gamut mapping). In the following paragraphs, the reference colour space, to which reference is made, needs to include the viewing conditions and reference medium when the perceptual intent is being considered. For the perceptual rendering intent, profile builders are expected to undertake any corrections for appearance effects if the viewing conditions used for monitors and transmitting media (such as dark surrounds) differ from those typical for reflecting media, and to account for differences between actual media and the reference medium.

Figure 1 shows how a reference colour space can be used to provide the common interface for transformations between different colour encodings, as used by different devices, or even different operational modes of the same device. Without it, a separate transformation would be required for each pair of device modes. If there are n device modes to be supported in a system, and it is necessary to provide a transformation between each pair of device modes, n^2 transforms would need to be defined and n new transforms would need to be defined every time a new device mode was added. As a new printer device mode can consist simply of a new paper type, this is not a practical solution. By using a reference colour space, only n transforms need be defined and only one new transform needs to be defined each time a new device mode is added; whatever device-to-device transforms are needed can be constructed by linking the source and destination profiles using the reference colour space as the interface.

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Key

T colour management transform

Figure 1 — Use of a reference colour space

While images can be encoded directly in PCSXYZ or PCSLAB, this will not generally be the case. A number of colour encodings for open exchange have been standardized to meet a variety of needs. Depending on the use case, different bit depths, image states, reference media and colour gamuts are needed. Devices also have different characteristics resulting in different native encodings. Except for a few cases where default encodings for key system devices are used for exchange (like the sRGB encoding), it is not practical or productive to attempt to restrict system colour encoding support.

For reasons of precision, it is usually desirable to define the transformation between the colour data encoding and the profile connection space (PCS) at a high precision. If the transformation between a colour data encoding and the PCS is provided with an image file, it can be utilized when images are reproduced. In order that the transformation between the colour data encoding and the PCS can be interpreted by all applications it is important that it be defined in an open specification. The profile format defined in this document provides that specification.

0.4 Rendering intents

In general, actual device colour gamuts will fail to match each other, and that of the perceptual intent reference medium, to varying degrees. Because of this mismatch, and because of the needs of different applications, four rendering intents (colour rendering styles) are defined in this document. Each one represents a different colour reproduction objective. The colorimetric rendering intents operate directly on measured colorimetric values, with correction for chromatic adaptation when the measured values were not obtained relative to the PCS adopted white chromaticity. The other rendering intents (perceptual and saturation) operate on colorimetric values which are adjusted in an as-needed fashion to account for any differences between devices, media, and viewing conditions.

Two colorimetric rendering intents are specified in this document, though only one is included fully constructed in the profile. The included media relative colorimetric intent is based on media-relative colorimetry, which is normalized relative to the media white for reflecting, transmitting, and self-luminous media, or, in the case of colour encodings and capture, to the colour encoding values that correspond to the highest perceived brightness. Thus, the media white will have the values of 100, 0, 0 in PCSLAB. This ensures that highlight clipping will not occur when the media-relative colorimetric intent is used. The use

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of media-relative colorimetry enables colour reproductions to be defined which maintain highlight detail, while keeping the medium 'white', even when the original and reproduction media differ in colour. However, this rendering intent introduces some change in all colours in the reproduction when the media whites of the source and destination do not match.

The PCS adopted white is defined to be the radiance of a perfect reflecting diffuser illuminated by a source with a spectral power distribution matching that of CIE Illuminant D50. ICC profiles contain the values of the media white, adapted to be relative to the chromaticity of the PCS adopted white. For the ICC-absolute colorimetric rendering intent, all of the colorimetric values are re-calculated to be relative to the tristimulus values of the PCS adopted white. When source and destination viewing conditions are identical and an exact colour match is required for all within-gamut colours (including the source medium colour), it is recommended that the ICC-absolute colorimetric rendering intent is used. This rendering intent can also be useful in other situations.

The colour rendering of the perceptual and saturation rendering intents is vendor specific. The former, which is useful for general reproduction of pictorial images, typically includes tone scale adjustments to map the dynamic range of one medium to that of another, and gamut reshaping and mapping to deal with gamut mismatches. The latter has historically been useful for images which contain objects such as charts or diagrams, and usually involves compromises, such as trading off preservation of hue in order to preserve the vividness of pure colours. As the saturation rendering intent is neither required to contain colorimetric characterization information or to use the perceptual intent reference medium, it is the only option, in proprietary systems, for providing colour rendering and re-rendering transforms to and from custom reference media represented in the PCS. For broader interoperability when using the saturation rendering intent, the perceptual reference medium can be used, and its use indicated.

For perceptual transforms it is necessary, in order to optimize colour rendering, to provide a realistic target for the colour rendering. For this reason, a reference medium and reference viewing condition have been defined which apply only to the perceptual rendering. The reference medium is defined as a hypothetical reflection print on a substrate with a white having a neutral reflectance of 89 %, and a density range of 2,459 3. The reference viewing condition is the P2 condition specified in ISO 3664, i.e. D50 at 500 lx for viewing reflecting media. A neutral surround of 20 % reflectance is assumed. The colour gamut of the reference medium is qualitatively specified as that of a reflection print, and whatever colour gamut is used in the PCS is required to be consistent with the specified dynamic range of the perceptual reference medium. It is recommended that the reference gamut specified in ISO 12640-3 be used as a more explicit target gamut for improved interoperability. It is recommended that profile creators consider this gamut to be the target for perceptual intent colour rendering and re-rendering to the PCS. Likewise, the perceptual intent colour re-rendering from the PCS needs to assume this gamut as the starting gamut for colour re-rendering to the destination medium. However, even when the use of this gamut is indicated, perceptual intent transforms need to be designed to produce the best visual results, and need not conform exactly to this gamut in the PCS.

The choice of a reference medium with a realistic black point for the perceptual intent provides a well-defined aim when colour rendering or re-rendering are required. Inputs with a dynamic range greater than a reflection print (e.g. a slide film image, or the colorimetry of high-range scenes) can have their highlights and shadows smoothly compressed to the range of the reference medium in such a way that these regions can be expanded again without undue loss of detail on output to wide-range media. Likewise, images from original media with limited dynamic range can be colour re-rendered to the expanded dynamic range of the reference medium, in order to produce better quality in subsequent reproductions. Bi-directional transform pairs (e.g. data-to-PCS and PCS-to-data for each rendering intent) in the profiles can be used to undo prior PCS-to-data colour re-rendering so that a differently optimized reproduction can be produced for a different reproduction medium.

Profiles generally offer different transformations for different rendering intents. When the rendering intent is selected the corresponding transformation is selected by the colour management system. The choice of rendering intent is highly dependent upon the intended use. In general, the perceptual rendering intent is most applicable for the colour re-rendering of natural images, to make pleasing and aesthetically similar, but not exactly matching, reproductions on different media. The ICC-absolute colorimetric rendering intent is most appropriate for a proofing environment, where the colour reproduction obtained on one device is simulated on another. The media-relative colorimetric rendering intent is appropriate when mapping of the source medium white to the destination medium white is desired, but a full colour re-rendering is not.

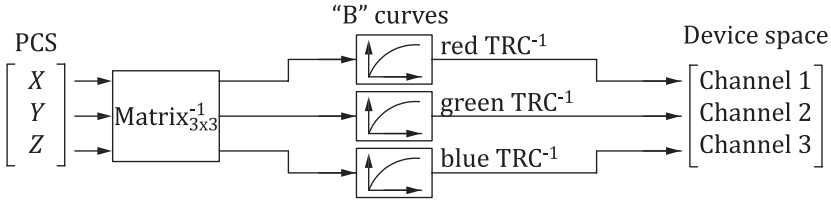
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For those requiring further information, an extended discussion of many of the issues described above is provided in Annex D.

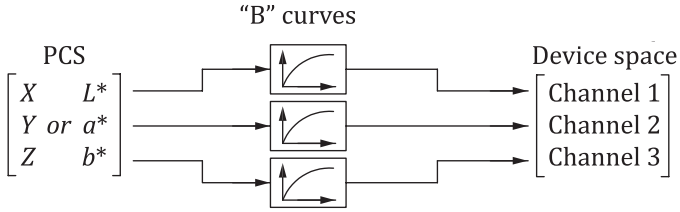
0.5 Colour profiles

Colour profiles provide colour management systems with the information necessary to convert colour data between different colour encodings, including device encodings. This document divides colour devices into three broad classifications, i.e. input devices, display devices and output devices. For each device class, a series of base algorithmic models are described which perform the transformation between colour encodings. Figures 2 and 3 show examples of these models, which provide different trade-offs in memory footprint, colour quality and performance results. The matrix tone reproduction curve (TRC) model is explained in detail in 8.3.3 and 8.4.3, the lutAToBType and lutBToAType in 10.10 and 10.11, and the multiProcessElementsType in 10.14. The necessary parameter data to implement these models is described in the appropriate tag type descriptions in Clause 10. This required data provides the information for the colour management framework default colour management module (CMM) to transform colour information between colour encodings. A representative architecture using these components is illustrated in Figure 4.

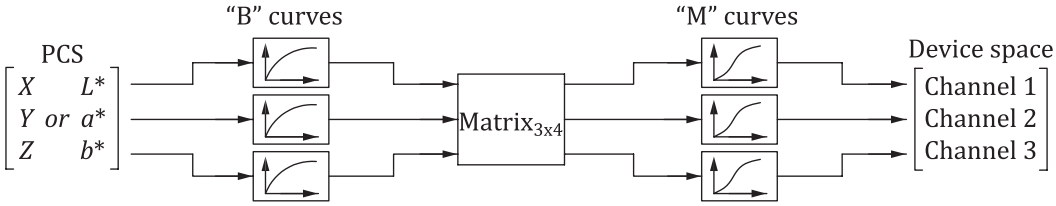
NOTE Only the models shown in Figures 2 d), e), f) and Figures 3 d), e) and f) can be used if the device space has more than three components/colours.



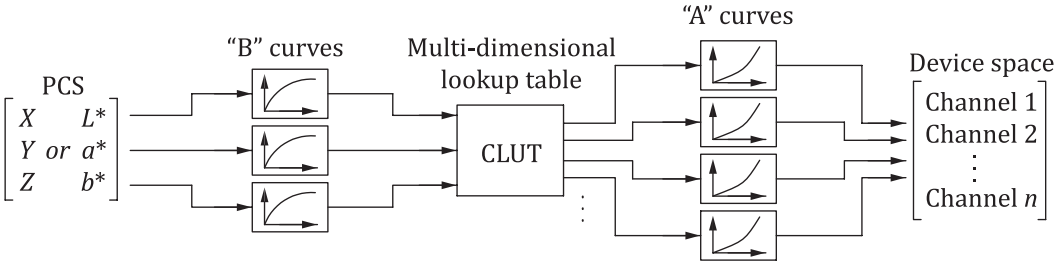
a) Using a matrix/TRC model



b) Using a lutBToAType model

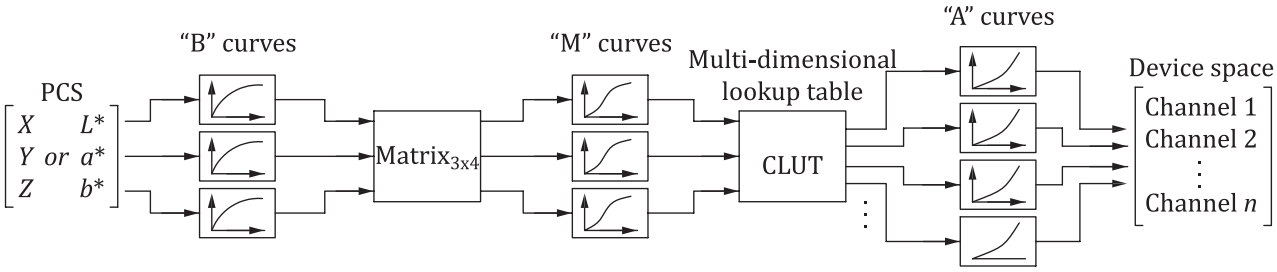


c) Using a lutBToAType model

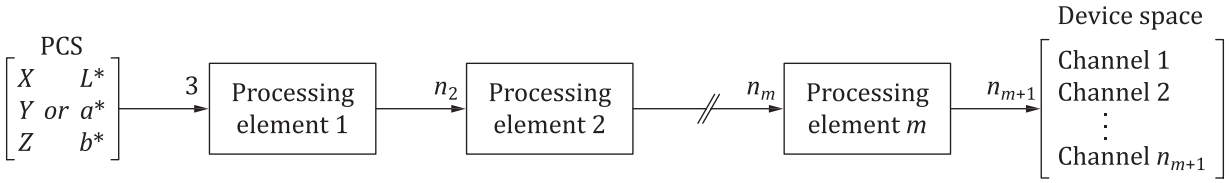


d) Using a lutBToAType model

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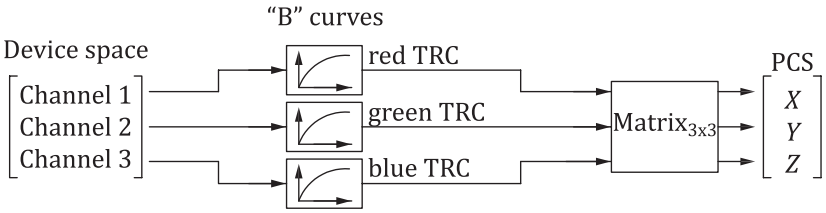


e) Using a lutBToAType model

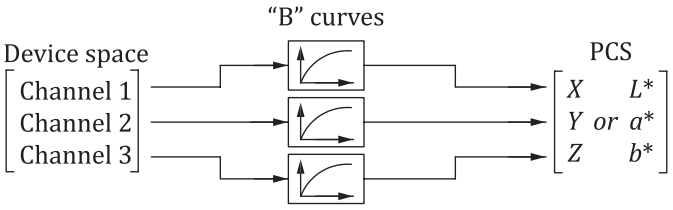


f) Using a multiProcessElementsType tag

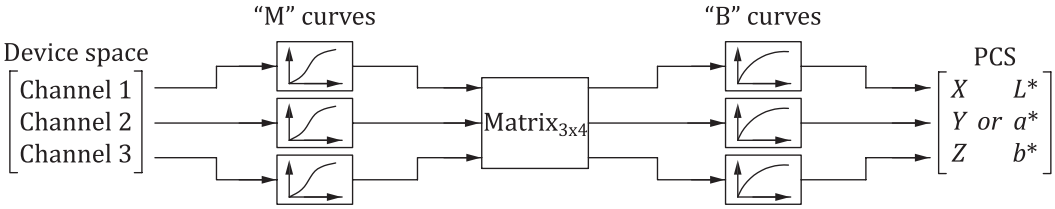
Figure 2 — Examples of different ways of converting a colour from PCS to device space



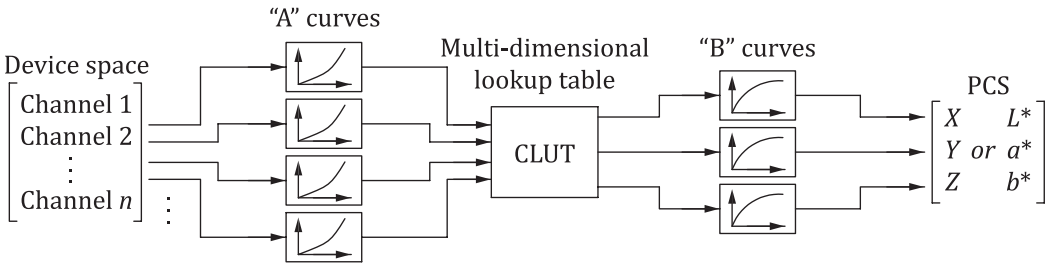
a) Using a matrix/TRC model



b) Using a lutAToBType model

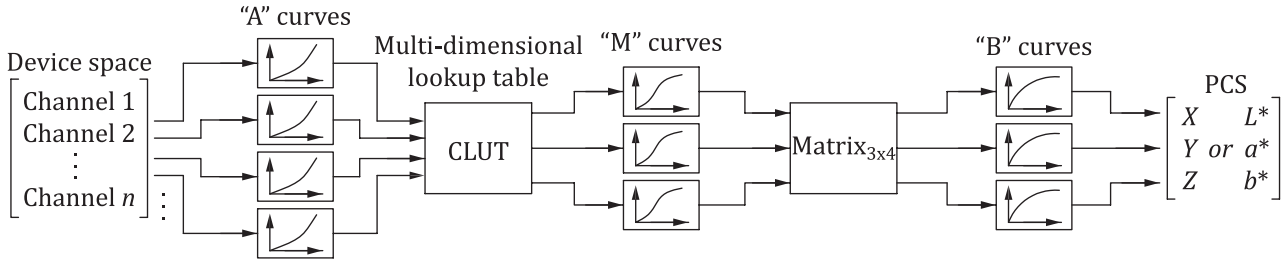


c) Using a lutAToBType model

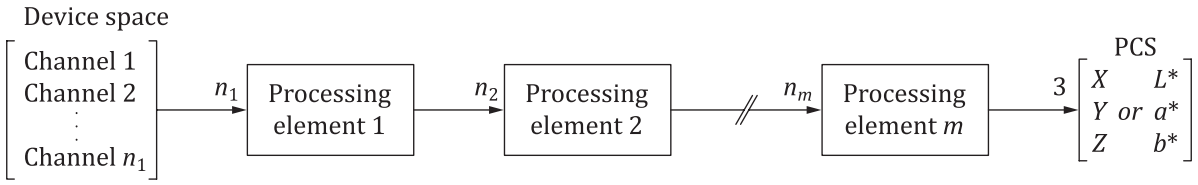


d) Using a lutAToBType model

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e) Using a lutAToBType model



f) Using a multiProcessElementsType tag

Figure 3 — Examples of different ways of converting a colour from device to PCS

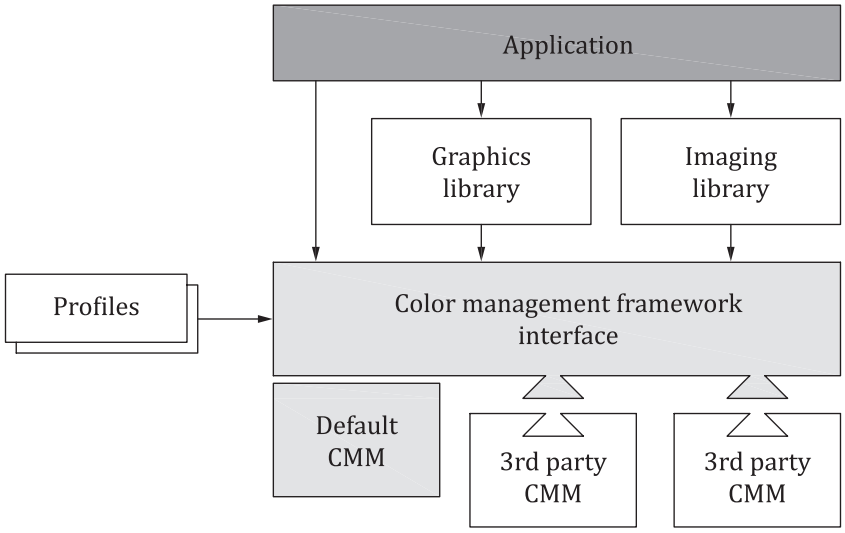


Figure 4 — Colour management architecture

0.6 Profile element structure

The profile structure is defined as a header followed by a tag table followed by a series of tagged elements that can be accessed randomly and individually. This collection of tagged elements provides three levels of information for developers: required data, optional data and private data. An element tag table provides a table of contents for the tagging information in each individual profile. This table includes a tag signature, the beginning address offset and size of the data for each individual tagged element. Signatures in this document are defined as a 4-byte hexadecimal number. This tagging scheme allows developers to read in the element tag table and then randomly access and load into memory only the information necessary to their particular software application. Since some instances of profiles can be quite large, this provides significant savings in performance and memory. The detailed descriptions of the tags, along with their intent, are included later in this document.

The required tags provide the complete set of information necessary for the CMM to translate colour information between the PCS and the data colour encoding. Each profile class determines which combination of tags is required.

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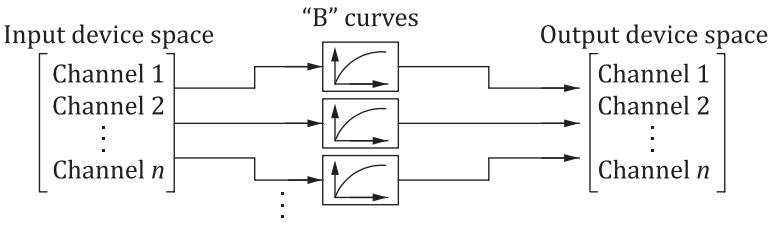
In addition to the required tags for each colour profile, a number of optional tags are defined that can be used for enhanced capabilities. In the case of required and optional tags, all of the signatures, an algorithmic description (where appropriate), and intent are registered with the International Color Consortium. Private data tags allow CMM developers to add proprietary value to their profiles. By registering just the tag signature and tag type signature, developers are assured of maintaining their proprietary advantages while maintaining compatibility with this document. However, since the overall philosophy of this format is to maintain an open, cross-platform standard, developers are encouraged to keep the use of private tags to an absolute minimum.

0.7 Embedded profiles

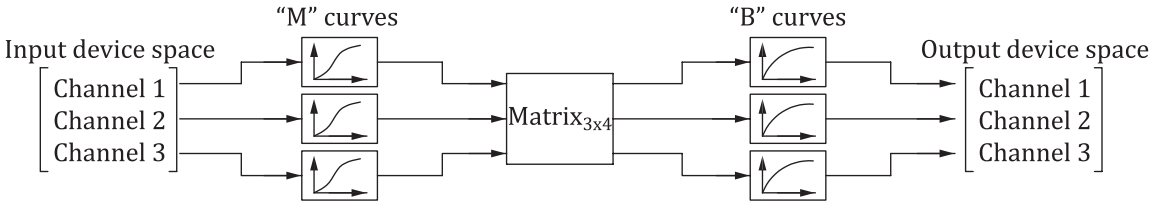
In addition to providing a cross-platform standard for the colour profile format, this document also describes the convention for embedding these profiles within graphics documents and images. Embedded profiles allow users to transparently move colour data between different computers, networks and even operating systems without having to worry if the necessary profiles are present on the destination systems. The intention of embedded profiles is to allow the interpretation of the associated colour data. Embedding profiles is described in ICC Technical Note 10-21 [20].

0.8 Other profiles

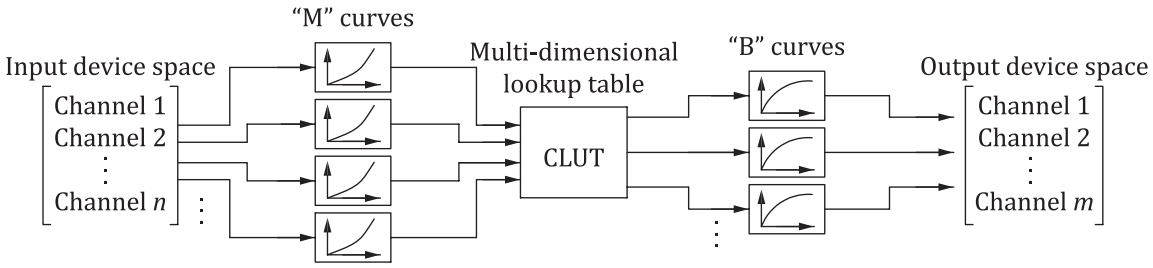
Four profile types, in addition to the device profile types described above, are defined in this document. DeviceLink profiles provide a dedicated transformation from one device encoding to another, which can be useful in situations where such a transformation is used frequently or has required optimisation to achieve specific objectives. (Figure 5 shows the various algorithmic models which can be used to construct a DeviceLink profile.)



a) Using a TRC model

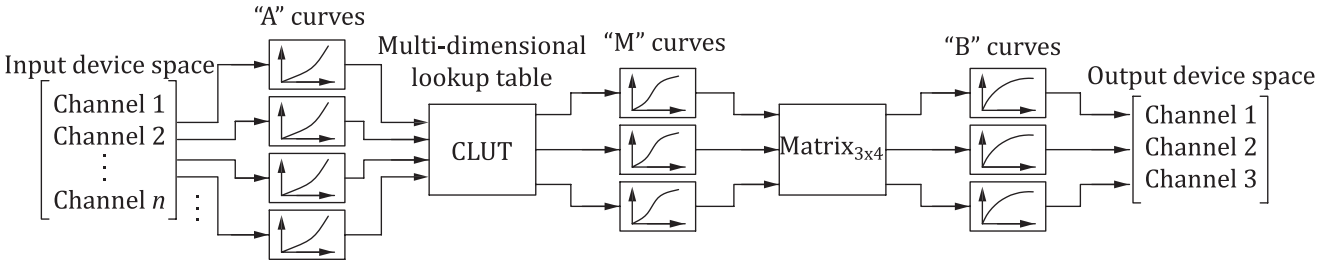


b) Using a matrix and TRC model

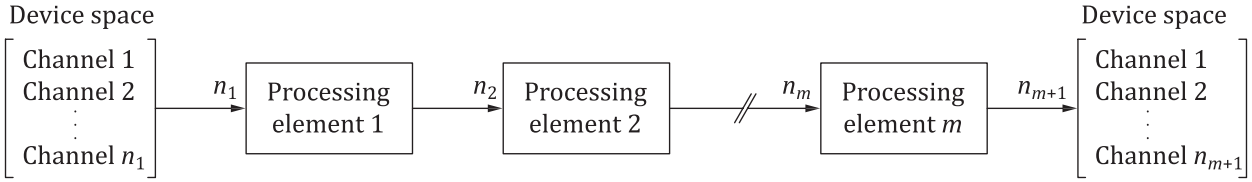


c) Using a colour lookup table (CLUT), and a TRC model

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d) Using a CLUT, a matrix, and a TRC model



e) Using a multiProcessElementsType tag

Figure 5 — Examples of converting a colour from device to device using a DeviceLink profile

ColorSpace profiles provide transformations between standard colour encodings and the PCS, providing a means for supporting existing and future colour encodings with backward compatibility. Abstract profiles are defined from PCS to PCS and enable colour transformations to be defined that provide some specific colour effects. NamedColor profiles provide a mechanism for specifying the relationship between device values and the PCS for specific colours, rather than for general images.

0.9 Organizational description of this document

This document addresses a very complex set of issues and it has been organized to provide a clear, clean, and unambiguous explanation of the entire format. To accomplish this, the overall presentation is from a top-down perspective, beginning with the summary overview presented above, followed by the necessary background information and definitions needed for unambiguous interpretation of the text. A description of the PCS and rendering intents is then provided before continuing down at increasing levels of detail into a byte stream description of the format. Clause 6 describes the PCS and rendering intents; Clause 7 describes the structure of the various fields required in a profile; and Clause 8 describes the content of the required tags for each profile class. Clause 9 lists the various tags (optional and required) and briefly summarizes the function of the tags as well as listing the signature and permitted tag types for each. The tag types are defined in Clause 10. Annex A provides additional information pertaining to the data colour encodings and rendering intents used in this document. Annex C provides a general description of the PostScript Level 2 tags used in this document while Annex D provides some background material on the PCS. Annex E provides additional information pertaining to chromatic adaptation and the chromaticAdaptationTag while Annex F describes some computational models assumed in this document. Annex G summarizes in tabular form the required tags for each profile class as specified in Clause 8. Annex H describes the relationship between this document and the ICC.2 specification.

0.9.1 Normalisation and numeric ranges

A convention adopted in the ICC architecture is to normalise data for PCS processing to the range 0 to 1 inclusive. This range is expressed in this document as [0 1].

0.10 Patent information

ISO draws attention to the fact that it is claimed that conformance with this document can involve the use of a patent concerning the outputResponseTag, (support of the outputResponseTag is optional), given in 9.2.36. Further information can be obtained from the ICC patent database[2].

2) Available from: https://www.color.org/ip/patents.xalter

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Image technology colour management — Architecture, profile format and data structure —

Part 1:
Based on ICC.1:2022

1 Scope

This document specifies a colour profile format and describes the architecture within which it can operate. This architecture supports the exchange of information which specifies the intended colour image processing of digital data. The required reference colour spaces and the data structures (tags) are also specified.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-3, *Photography and graphic technology — Density measurements — Part 3: Spectral conditions*

ISO 639, *Code for individual languages and language groups*

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

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country code*

ISO 3664, *Graphic technology and photography — Viewing conditions*

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

ISO/IEC 23091-2, *Information technology — Coding-independent code points — Part 2: Video*

DIN 16536-2, *Testing of prints and printing inks in graphic technology — Colour density measurements on on-press or off-press prints — Part 2: Instrument specifications for reflection densitometers and their calibration*

EBU Tech. 3213-E, *EBU standard for chromaticity tolerances for studio monitors*

ITU-R BT.709-2, *Parameter values for the HDTV standards for production and international programme exchange*

SMPTE RP145, *SMPTE C Color Monitor Colorimetry*[3)]

Internet R.F.C. 1321, *The MD5 Message-Digest Algorithm*, R. Rivest, April 1992, Available from Internet <ftp://www.ietf.org/rfc/rfc1321.txt>

IEEE 754, *Standard for Binary Floating-Point Arithmetic*[4)]

ICC Tag Registry[5)]

3) Available from: <https://store.smpte.org/category-s/22.htm>

4) Available from: <http://ieeexplore.ieee.org>

5) Available from https://www.color.org/registry/signature/TagRegistry/

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3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
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 can vary within a scene.

Note 2 to entry: No assumption is to be made concerning the relationship 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 can affect perception. It is easy to arrange conditions for which a near perfectly reflecting diffuser will appear to be grey or coloured.

[SOURCE: ISO 22028-1:2016 3.4]

3.1.2
ASCII text string
sequence of bytes, each containing a graphic character specified in ISO/IEC 646, the last character in the string being a NULL (character 0/0)

3.1.3
big-endian
order of addressing the bytes within a 16-bit, 32-bit or 64-bit value, from the most significant to the least significant, as the byte address increases

3.1.4
bit position
position of a bit within a field

Note 1 to entry: bits are numbered such that bit 0 is the least significant bit.

3.1.5
byte
8-bit unsigned binary integer

3.1.6
byte offset
number of bytes from the beginning of a field

3.1.7
CIELAB
CIE 1976L^*, a^* and b^* values calculated from nCIEXYZ according to CIE 15

3.1.8
CIEXYZ
XYZ tristimulus values based on the CIE 1931 Standard Colorimetric Observer as defined in CIE 15

Note 1 to entry: Y is expressed in candelas per square metre.

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3.1.9
nCIEXYZ
CIEXYZ values that have been uniformly scaled so that Y = 1,0 for the adopted white

Note 1 to entry: In the ICC specification, this is referred to as ICC-absolute colorimetry.

3.1.10
colour encoding
generic term for a quantized digital encoding of a colour space, encompassing both colour space encodings and colour image encodings

Note 1 to entry: Values specified by an encoding are the closest representation to the colour space or image values permitted by the encoding precision.

[SOURCE: ISO 22028-1:2016, 3.7, modified — Note to entry has been added]

3.1.11
colour management
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

Note 1 to entry: Colour content can consist of text, line art, graphics, and pictorial images, in raster or vector form, all of which can be colour managed.

Note 2 to entry: Colour management considers the characteristics of input and output devices in determining colour data conversions for these devices.

3.1.12
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 22028-1:2016, 3.11]

3.1.13
encoding maximum white
highest luminance achromatic colour that can be represented using a specified colour encoding

Note 1 to entry: For the purpose of this definition, a colour is achromatic if it has the same chromaticity as the adopted white. The choice of the adopted white is an user decision.

3.1.14
fixed point
method of encoding a real number into binary by putting an implied binary point at a fixed bit position

Note 1 to entry: Many of the tag types defined in this ICC specification contain fixed point numbers. Several references can be found (MetaFonts, etc.) illustrating the benefit of fixed point representation when compared to pure floating point representation in very structured circumstances.

3.1.15
hexadecimal
numeral system with a radix, or base, of 16, written using the symbols 0–9 and A–F, or a–f

Note 1 to entry: The notation used to indicate hexadecimal numbers in this ICC specification is xxh.

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3.1.16
image state
attribute of a colour image encoding indicating the rendering state of the image data

[SOURCE: ISO 22028-1:2016 3.25]

3.1.17
imaging medium
surface from or through which light is emitted, reflected or transmitted to produce an image

3.1.18
medium black point
reference colour that is used in black point compensation transforms

Note 1 to entry: In a reproduction process, this is usually the near-neutral colour with the lowest luminance that can be produced by an imaging medium, measured using the specified measurement geometry. In a capture process this is usually the colour associated with the device side encoding minimum.

3.1.19
media white point
reference colour that is used as the basis for scaling of media relative transforms

Note 1 to entry: In a reproduction process, the media white point is usually the near-neutral colour with the highest luminance that can be produced by an imaging medium, measured using the specified measurement geometry. In the case where a layer of white ink is printed on the imaging medium, the media white point is usually the colour of this white ink as printed on the imaging medium.

Note 2 to entry: In a capture process the media white point is usually the colour associated with the device side encoding maximum white..

3.1.20
NULL
null
character coded in position 0/0 as specified in ISO/IEC 6429

3.1.21
PCS
profile connection space
colour space used to connect the source and destination profiles

Note 1 to entry: See Annex D for a full description.

3.1.22
PCS adopted white
adopted white where the spectral radiance distribution is that of the PCS illuminant

3.1.23
PCS illuminant
illuminant with the spectral radiance distribution of CIE illuminant D50 and nCIEXYZ X = 0,964 2, nCIEXYZ Y = 1,0, nCIEXYZ Z = 0,824 9

3.1.24
PCSLAB
CIELAB values calculated from PCSXYZ

3.1.25
PCSLAB encoding
PCSLAB values that have been encoded as 8-bit or 16-bit numbers, or as floating point numbers

3.1.26
PCSXYZ
nCIEXYZ values that have been linearly scaled so that PCSXYZ X = 0,964 2, PCSXYZ Y = 1,0, PCSXYZ Z = 0,824 9 for media white

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3.1.27
PCSXYZ encoding
PCSXYZ values that have been encoded as 16-bit numbers, or as floating point numbers

3.1.28
picture-referred image state
image state associated with image data that represents the colour-space coordinates of the elements of a hardcopy or softcopy image, encompassing both original-referred image data and output-referred image data

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

Note 2 to entry: Picture-referred image data will generally be colour-rendered for a specific real or virtual imaging medium and viewing condition.

Note 3 to entry: Picture-referred image data can include image data that do not originate from an original scene, such as text, line art, vector graphics and other forms of original artwork.

[SOURCE: ISO 22028-1:2016 3.33]

3.1.29
rendering intent
style of mapping colour values from one image description to another

Note 1 to entry: See Clause 6 and Annexes A and D for a description of the four rendering intents (ICC-absolute colorimetric, relative colorimetric, perceptual and saturation) used in ICC profiles

3.1.30
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 can correspond to an actual view of the natural world or to a computer-generated virtual scene simulating such a view.

[SOURCE: ISO 22028-1:2016 3.34]

3.1.31
spot colour
single colorant, identified by name, whose printing tone-values are specified independently from the colour values specified in a colour coordinate system

3.1.32
signature
alphanumerical 4-byte value, registered with the ICC

Note 1 to entry: Shorter values are padded at the end with 20h bytes.

3.1.33
viewing flare
veiling glare that is observed in a viewing environment but not accounted for in radiometric measurements made using a prescribed measurement geometry

[SOURCE: ISO 22028-1:2016 3.43]

Note 1 to entry: The viewing flare is expressed as a percentage of the luminance of adapted white.

3.1.34
veiling glare
light, reflected from an imaging medium, that has not been modulated by the means used to produce the image

[SOURCE: ISO 22028-1:2016 3.42]

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3.2 Abbreviated terms

ANSI	American National Standards Institute
CIE	*Commission Internationale de l'eclairage* (International Commission on Illumination)
CICP	Coding-independent code points for video signal type identification
CLUT	Colour lookup table (multi-dimensional)
CMM	Colour management module
CMY	Cyan, magenta, yellow
CMYK	Cyan, magenta, yellow, key (black)
CRD	Colour rendering dictionary
CRT	Cathode-ray tube
EPS	Encapsulated PostScript
ICC	International Color Consortium
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LCD	Liquid crystal display
LUT	Lookup table
PCS	Profile connection space
RGB	Red, green, blue
TIFF	Tagged Image File Format
TRC	Tone reproduction curve

4 Basic number types

4.1 General

The basic numeric types used in this ICC specification are defined in 4.2 to 4.15.

NOTE As defined in 7.1, all profile data is encoded as big-endian.

4.2 dateTimeNumber

A dateTimeNumber is a 12-byte value representation of the time and date, where the byte usage is assigned as specified in Table 2. The actual values are encoded as 16-bit unsigned integers (uInt16Number, see 4.10).

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