

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

Part 1: Based on ICC.1:2004-10

ICS 37.100.99

National foreword

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
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Summary of pages

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

Part 1: Based on ICC.1:2004-10

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

Partie 1: Sur la base de l'ICC.1:2004-10



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Foreword

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15076-1 was prepared by the *International Color Consortium*, in cooperation with Technical Committees ISO/TC 130 *Graphic technology* and ISO/TC42 *Photography*, under the provisions of the Cooperative Agreement between ISO/TC130 and the *International Color Consortium* dated 2003-07-11.

ISO 15076-1 is technically identical to ICC.1:2004-10, *Image technology colour management — Architecture, profile format, and data structure (Profile version 4.2.0.0)*.

ISO 15076 consists of the following parts, under the general title *Image technology colour management — Architecture, profile format, and data structure*.

— *Part 1: Based on ICC.1:2004-10*

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Introduction

0.1 General

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

It is assumed that the reader has a nominal understanding of colour science, such as familiarity with the CIELAB colour space, general knowledge of device characterizations, 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 profile format standard, and for the registration of tag signatures and descriptions. The founding members of this consortium were: Adobe Systems Inc., Agfa-Gevaert N.V., Apple Computer, Inc., Eastman Kodak Company, FOGRA (Honorary), Microsoft Corporation, Silicon Graphics, Inc., Sun Microsystems, Inc., and Taligent, Inc. These companies committed to fully support the standard in their operating systems, platforms and applications. The consortium has since been expanded and now has over 60 members.

The initial version of the standard developed by the consortium has undergone various revisions and it was agreed by ICC that its revision 4.2 should be proposed as an International Standard. It is that revision which has formed the basis of this International Standard. The ICC will continue to administer its own version of the document and, if enhancements are made, they will be seriously considered for future revisions of this International Standard. ISO TC130 will work to ensure that there are no significant differences between the ICC and ISO versions of the document.

The ICC web site (www.color.org) provides supplementary information relevant to this International Standard 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 International Standard 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 (XYZ) to be specified for a coloured stimulus. These tristimulus values enable a user to determine whether colours match, and the degree of mis-match between any that do not. It follows that it is possible to define the colour of a sample by these tristimulus values (or some defined transformation of them) for matching by colour reproduction.

Calculation of the XYZ 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 illuminant used to view it and the 'sensitivity' of the standard observer. However, as CIE defines two standard observers, two measurement geometries (for reflecting media) and a large number of illuminants, it is necessary to restrict these options in order to have a system that is not ambiguous for a particular application. For this International Standard ICC have defined such a restriction, based on ISO 13655:1996, Graphic Technology - Spectral measurement and colorimetric calculation for graphic arts images, and the resultant colour space is known as the Profile Connection Space (PCS). Furthermore, the simple CIE system (whether XYZ 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 level of 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 simply describes the colorimetry of actual originals and their reproductions through the colorimetric 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. Thus it may incorporate corrections for appearance, and other desired rendering effects, as well as accommodating differences between the device and the reference PCS dynamic range. When required the viewing conditions may be specified to allow appearance to be determined for the colorimetric rendering intents.

So, in summary, the PCS is based on XYZ (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 (D50 - a chromatic adaptation transform is used if necessary), and measured with a specified measurement geometry ($0^\circ/45^\circ$ or $45^\circ/0^\circ$), for reflecting media. Measurement procedures are also defined for transmitting media. (Since the conversion from XYZ to CIELAB is quite unambiguous profile builders can use either, and the application is able to determine which has been used from a tag in the header).

For colorimetric renderings, where the measured data was not made relative to D50 the profile builder is expected to correct the data to achieve this. However a mechanism for identifying the chromatic adaptation used in such situations is provided. For the perceptual rendering intent the same viewing conditions are assumed, but an additional constraint is added in that a reference medium and illumination level is specified in order to provide a more robust mechanism for describing colour rendering (including gamut mapping). In the following paragraphs the reference colour space referred to should be taken 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.

Figure 1 shows how a reference colour space can be used to provide the common interface for colour specification between devices. Without it a separate transformation would be required for each pair of devices. If there are n devices in a system, and it is necessary to provide a transformation between each device and every other device, n^2 transforms would need to be defined and n new transforms would need to be defined every time a new device is added. By use of a reference colour space only n transforms need be defined and only one new transform needs to be defined each time a new device is added.

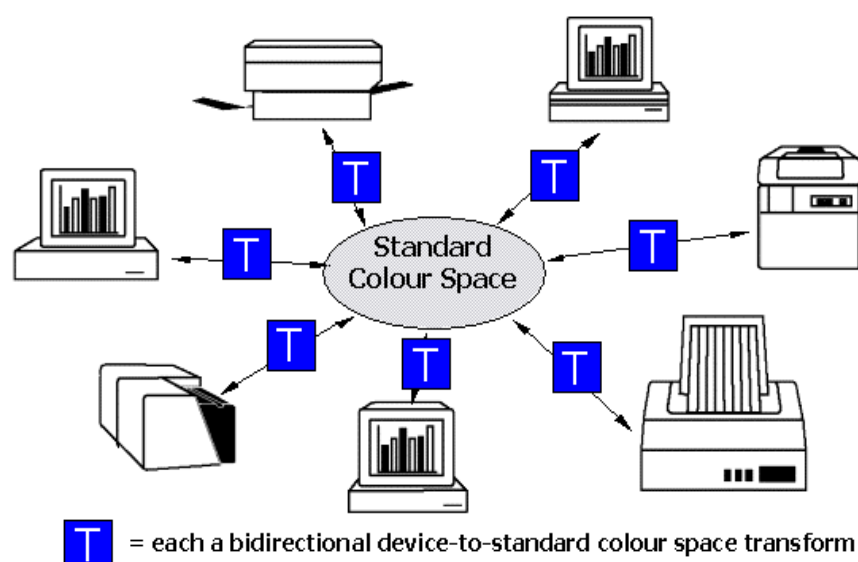


Figure 1 — Use of a reference colour space

While images could be encoded directly in the reference colour space defined by the PCS this will not generally be the case. For precision reasons it is usually desirable to define the transformation between the device colour space and the PCS at a higher precision than the bit-depth of the image. So, the transformation between a device colour space and the PCS is usually defined at high precision. If this transformation is provided with any image file appropriate to that device it can be utilised when images are reproduced. By combining the profiles

for the pair of devices for which image reproduction is required, using the common PCS as the interface as shown in Figure 1, appropriate colour reproduction is assured with a minimal loss of precision. In order that the transformation between the device colour space 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 International Standard provides that specification.

0.4 Rendering intents

In general, actual device colour gamuts will fail to match each other, and that of the 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 specification. Each one represents a different colour reproduction compromise. The colorimetric rendering intents operate directly on measured colorimetric values, though possibly with correction for chromatic adaptation when the measured values were not calculated for the D50 PCS illuminant. The other rendering intents (perceptual and saturation) operate on colorimetric values which are corrected in an as-needed fashion to account for any differences between devices, media, and viewing conditions.

Two colorimetric rendering intents are specified in this International Standard, though only one is directly defined in the profile. The defined colorimetric intent (media-relative colorimetric intent) is based on media-relative colorimetry in which data is normalised relative to the media white point for reflecting and transmitting media. (Thus the media white will have the PCS CIELAB values (100, 0, 0)). However, because the profile is also required to contain the PCS values of the media white, relative to the perfect reflecting diffuser or transmitter under D50, it is possible for all the media-relative values to be re-calculated relative to these. When this is done the resultant rendering intent is known as the absolute colorimetric intent. The use 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 procedure inevitably introduces some change in all colours in the reproduction. When an exact colour match is required for all within gamut colours the absolute colorimetric rendering intent will define this.

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 warping to deal with gamut mismatches. The latter, which is useful for images which contain objects such as charts or diagrams, usually involves compromises such as trading off preservation of hue in order to preserve the vividness of pure colours.

For perceptual transforms it is desirable, in order to optimise colour rendering, to place some bounds on the colour gamut of the PCS values. 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 print on a substrate with a white having a neutral reflectance of 89%, and a density range of 2,4593. The reference viewing condition is the P2 condition specified in ISO 3664 - Viewing conditions - for Photography and Graphic Technology, i.e. D50 at 500 lux for viewing reflecting media. A neutral surround, of 20% reflectance is assumed.

The choice of a reference medium with a realistic black point for the perceptual intent provides a well-defined aim when tonal remapping is required. Inputs with a dynamic range greater than a reflection print (for example, a slide film image, or the colorimetry of high-range scenes) can have their highlights and shadows smoothly compressed to the range of the print 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 rendered to the expanded dynamic range of the reference medium, in order to ensure interoperability.

Profiles generally offer more than one transformation, each of which is applicable to a specific rendering intent. When the intent is selected the appropriate transformation is selected by the colour management application. The choice of rendering intent is highly dependent upon the intended use. In general the perceptual rendering intent is most applicable for the rendering of natural images, though not always. In particular, in a proofing environment - where the colour reproduction obtained on one device is simulated on another - colorimetric rendering is most appropriate.

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

0.5 Device profiles

Device profiles provide colour management systems with the information necessary to convert colour data between native device colour spaces and device independent colour spaces. This International Standard divides colour devices into three broad classifications: 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 spaces. Figures 2 and 3 show examples of these models, which provide a range of colour

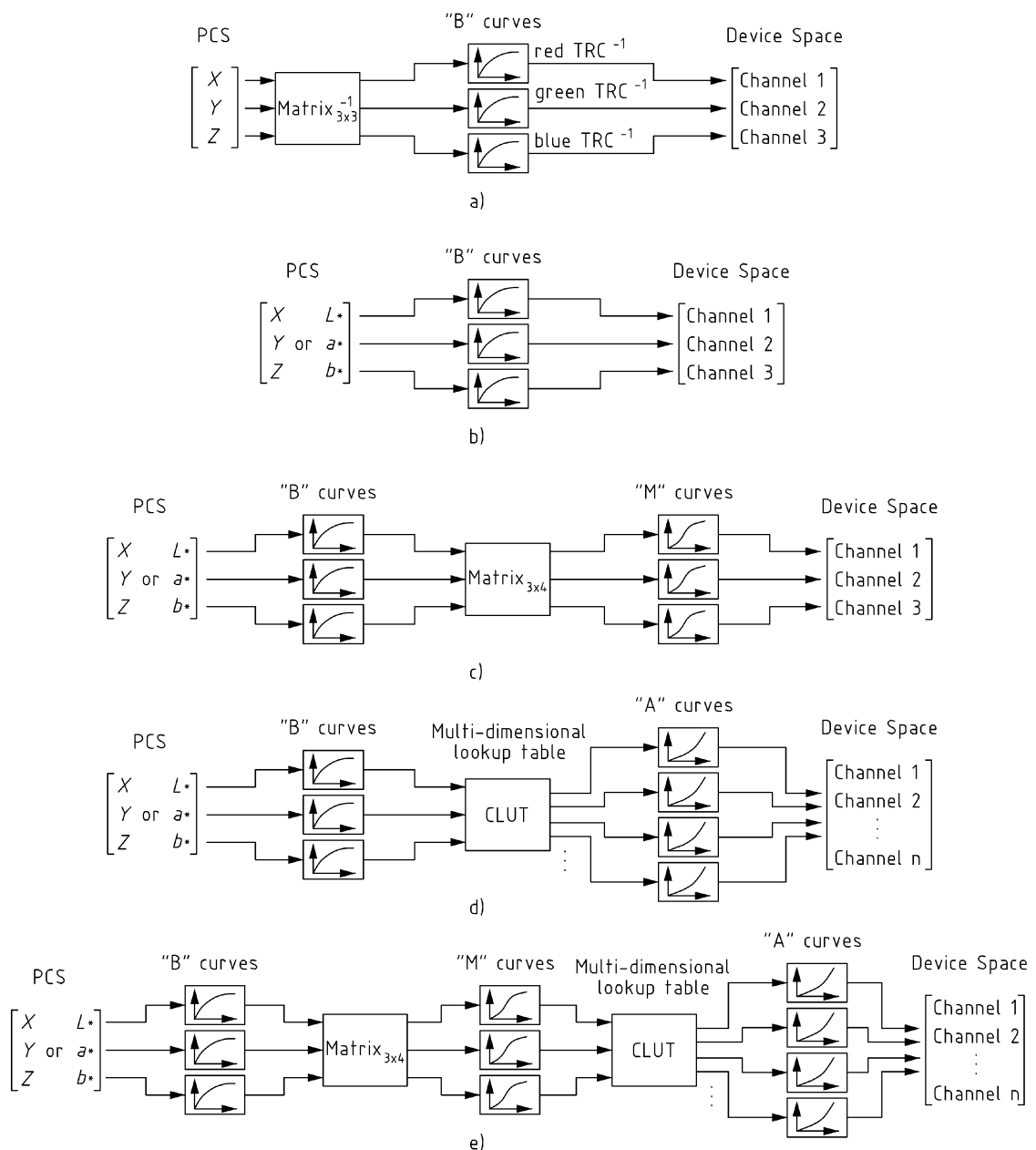


Figure 2 — The different ways of converting a colour from PCS to device space. (a) Matrix/TRC model (b)-(e) The four different ways of applying a lutBtoAType table. Only (d) and (e) can be used if the device space has more than 3 components/colour.

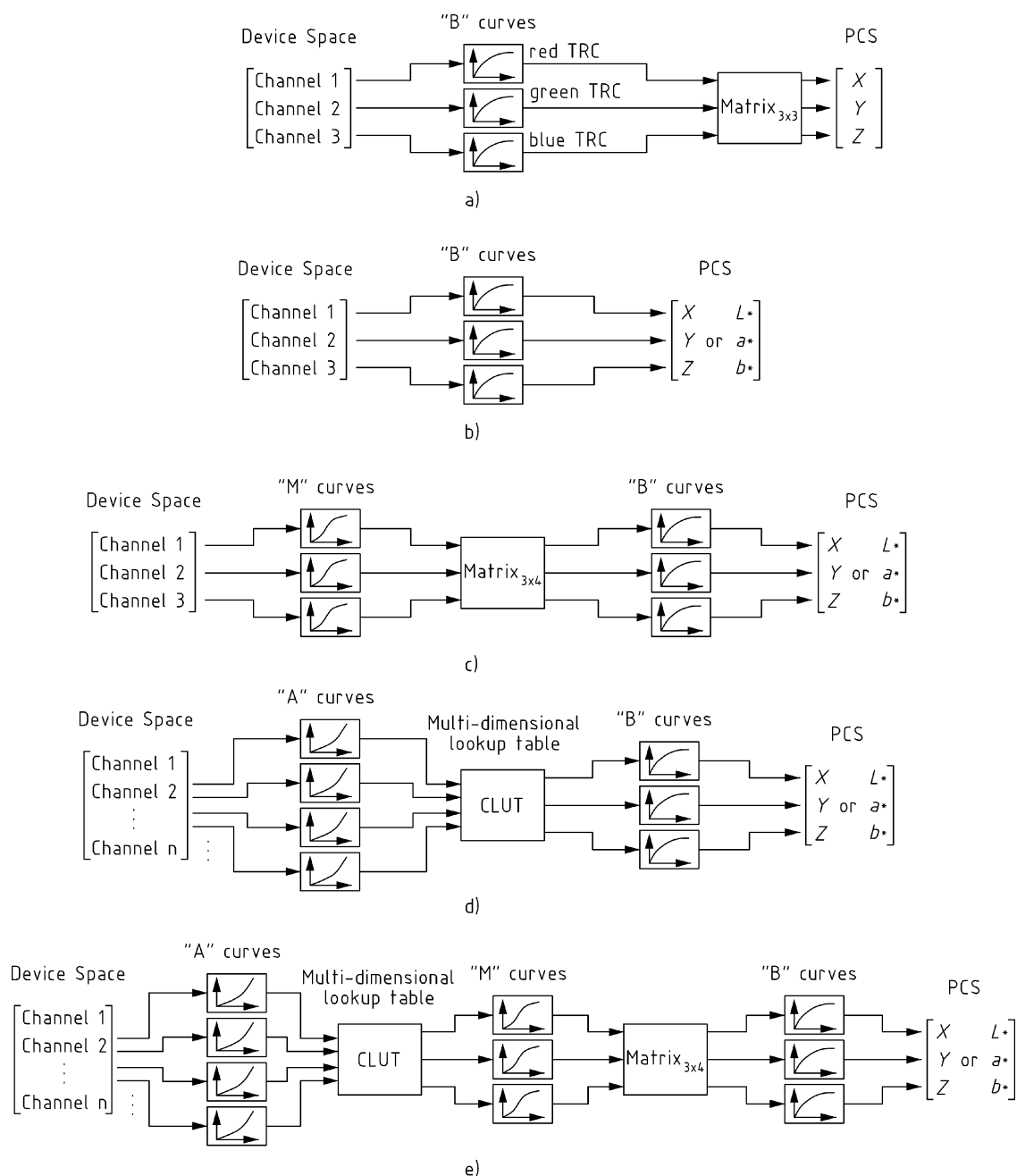


Figure 3 — Examples of converting a colour from device to PCS. (a) Matrix/TRC model (b)-(e) The four different ways of applying a lutAtoBType table. Only (d) and (e) can be used if the device space has more than 3 components/colour.

quality and performance results. Each of the base models provides different trade-offs in memory footprint, performance and image quality. 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 native device colour spaces. A representative architecture using these components is illustrated in Figure 4.

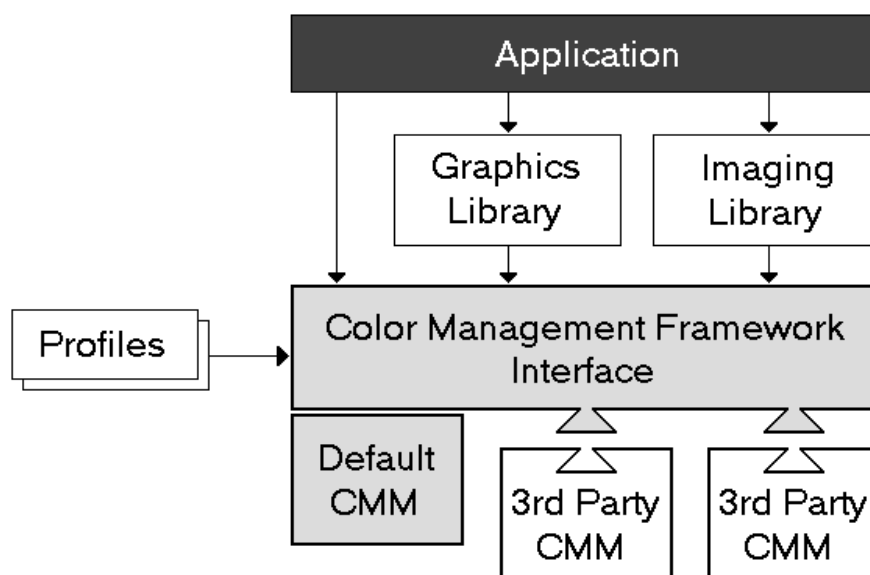


Figure 4 — Colour management architecture

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 International Standard are defined as a four-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 International Standard.

The required tags provide the complete set of information necessary for the default CMM to translate colour information between the Profile Connection Space and the native device space. Each profile class determines which combination of tags is required.

In addition to the required tags for each device profile, a number of optional tags are defined that can be used for enhanced colour transformations. Examples of these tags include PostScript Level 2 support, calibration support, and others. 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 International Standard. 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 actual disk-based profile format, this International Standard 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 specifications are described in Annex B of this document.

0.8 Other profiles

Four profile types, in addition to the device profile types described above, are defined in this specification. DeviceLink profiles provide a dedicated transformation from one device space 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 may be used to construct a DeviceLink profile.).

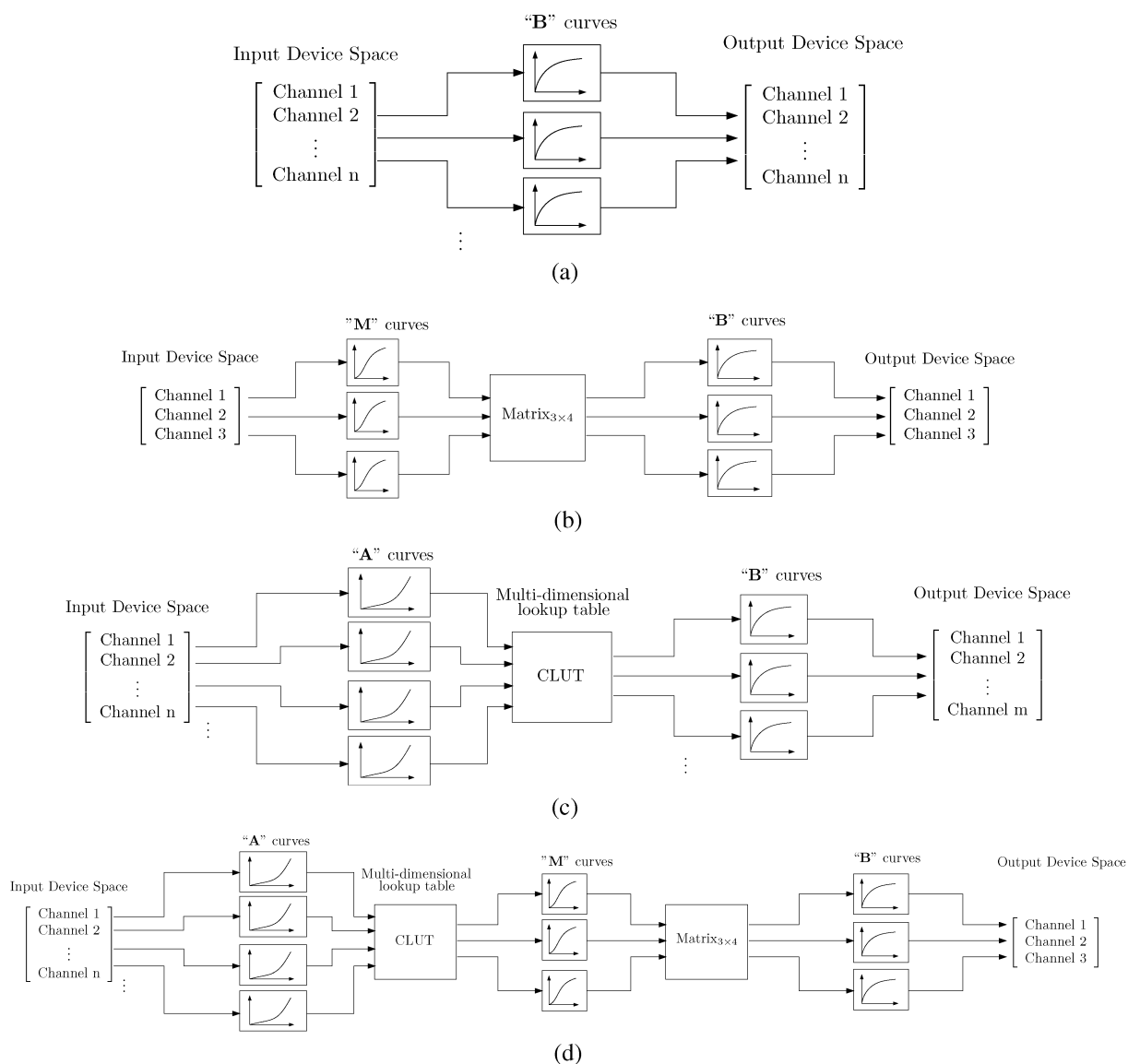


Figure 5 — Examples of converting a colour from device to device using a DeviceLink profile. (a) TRC model (b) Matrix/TRC model (c) CLUT, plus TRC model (d) CLUT, plus matrix, plus CRT model. Only (a), (c) and (d) can be used if the device space has more than 3 components/colour.

ColorSpace conversion profiles provide a transformation between a non-device colour space and the PCS, which can prove useful in workflows in which reference colour spaces different from those selected by ICC are utilised. Abstract profiles are defined from PCS to PCS and enable colour transformations to be defined that

provide some specific colour effects. Named Colour 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 International Standard

This International Standard addresses a very complex set of issues and the organization of this document strives 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 Profile Connection Space 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 Profile Connection Space 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 tag types (optional and required) and briefly summarises the function of the tag as well as listing the signature and allowed tag types for each. The tag types are defined in clause 10. Annex A provides additional information pertaining to the colour spaces and rendering intents used in this International Standard while Annex B provides the necessary details to embed profiles into PICT, EPS, TIFF, and JFIF files. Annex C provides a general description of the PostScript Level 2 tags used in this International Standard while Annex D provides some background material on the Profile Connection Space. Annex E provides additional information pertaining to Chromatic Adaptation and the chromaticAdaptationTag while Annex F describes some the computational models assumed in this International Standard. Annex G summarises in tabular form the required tags for each profile class as specified in clause 8.

0.10 Patent statement

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the outputResponseTag, (support of the outputResponseTag is optional), given in subclause 9.2.27. ISO takes no position concerning the evidence, validity and scope of this patent right. Eastman Kodak Company, the holder of this patent right has assured the ISO that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from Eastman Kodak Company, 343 State street, Rochester, NY 14650.

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

Part 1: Based on ICC.1:2004-10

1 Scope

This part of ISO 15076 specifies a colour profile format and describes the architecture within which it can operate. This supports the exchange of information which specifies the intended colour image processing of digital data. Specification of the required reference colour spaces and the data structures (tags) are included.

NOTE The technical content of this document is identical to that of ICC.1:2004-10.

2 Compliance and registration

Any colour management system, application, utility or device driver that claims conformance with this specification shall have the ability to read the profiles as they are defined in this specification. Any profile-generating software and/or hardware that claims conformance with this specification shall have the ability to create profiles as they are defined in this specification. ICC conforming software shall use the ICC profiles in an appropriate manner.

This specification requires that signatures for CMM type, device manufacturer, device model, profile tags and profile tag types shall be registered to insure that all profile data is uniquely defined. The registration authority for these data is the ICC Technical Secretary.

NOTE See the ICC Web Site (www.color.org) for contact information.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-3:1995, *Photography — Density measurements — Part 3: Spectral conditions*

ISO 639-1:2002, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange*

ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 3664:2000, *Viewing conditions — Graphic Technology and Photography*

ISO 13655:1996, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

IEC 61966-2-1 (1999-10), *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management — Default RGB colour space — sRGB*

IEC 61966-3 (2000-03), *Multimedia systems and equipment — Colour measurement and management — Part 3: Equipment using cathode ray tubes*

DIN 16536-2:1995, *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 RP 145-1994: *SMPTE C Color Monitor Colorimetry*

PICT Standard Specifications, Apple Computer, Inc.

PostScript Language Reference Manual, Third Edition, Adobe Systems Incorporated

TIFF 6.0 Specification, Adobe Systems Incorporated

Internet RFC 1321, *The MD5 Message-Digest Algorithm*, R. Rivest, April 1992, Available from Internet <[ftp://www.ietf.org/rfc/rfc1321.txt](http://www.ietf.org/rfc/rfc1321.txt)>

4 Terms and definitions

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

- 4.1**
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
- 4.2**
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)
- 4.3**
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
- 4.4**
bit position
bits are numbered such that bit 0 is the least significant bit
- 4.5**
byte
8-bit unsigned binary integer
- 4.6**
byte offset
number of bytes from the beginning of a field

4.7**colour encoding**

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

NOTE Values specified by an encoding are the closest representation to the colour space or image values permitted by the encoding precision.

4.8**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

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.

4.9**fixed point**

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

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.

4.10**hexadecimal**

number system used to represent the value of a 4-bit binary word

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

4.11**NULL**

character coded in position 0/0 of ISO/IEC 646

4.12**Profile Connection Space (PCS)**

abstract colour space used to connect the source and destination profiles

NOTE See Annex D for a full description.

4.13**rendering intent**

style of mapping colour values from one image description to another

NOTE 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.

4.14**spot colour**

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

4.15

signature

alphanumeric 4-byte value, registered with the ICC

NOTE Shorter values are padded at the end with 20h bytes.

4.16

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 22028-1]

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

4.17

veiling glare

light, reflected from an imaging medium, that has not been modulated by the means used to produce the image
[ISO 22028-1]

5 Basic numeric types and abbreviations

5.1 Basic number types

For the purposes of this document, the following basic numeric types are used as defined below:

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

5.1.1 dateTimeNumber

A 12-byte value representation of the time and date, where the byte usage is assigned as specified in table 1. The actual values are encoded as 16-bit unsigned integers (uint16Number - see 5.1.6).

Table 1 — dateTimeNumber

Byte Position	Field Length (bytes)	Content	Encoded as...
0..1	2	number of the year (actual year, e.g. 1994)	uint16Number
2..3	2	number of the month (1-12)	uint16Number
4..5	2	number of the day of the month (1-31)	uint16Number
6..7	2	number of hours (0-23)	uint16Number
8..9	2	number of minutes (0-59)	uint16Number
10..11	2	number of seconds (0-59)	uint16Number

All the dateTimeNumber values in a profile shall be in Coordinated Universal Time (UTC, also known as GMT or ZULU Time). Profile writers are required to convert local time to UTC when setting these values. Programmes that display these values may show the dateTimeNumber as UTC, show the equivalent local time (at current locale), or display both UTC and local versions of the dateTimeNumber.

5.1.2 response16Number

A 8-byte value, used to associate a normalized device code with a measurement value, where byte usage shall be assigned as specified in table 2.

Table 2 — response16Number

Byte Position	Field Length (bytes)	Content	Encoded as...
0..1	2	16-bit number in the interval [DeviceMin to DeviceMax]. NOTE DeviceMin is encoded as 0000h and DeviceMax is encoded as FFFFh	uInt16Number
2..3	2	reserved, must be zero	
4..7	4	measurement value	s15Fixed16Number

5.1.3 s15Fixed16Number

A fixed signed 4-byte/32-bit quantity which has 16 fractional bits as shown in table 3.

Table 3 — s15Fixed16Number

Number	Encoding
-32768,0	80000000h
0	00000000h
1,0	00010000h
$32767 + (65535/65536)$	7FFFFFFFh

5.1.4 u16Fixed16Number

A fixed unsigned 4-byte/32-bit quantity which has 16 fractional bits as shown in table 4.

Table 4 — u16Fixed16Number

Number	Encoding
0	00000000h
1,0	00010000h
$65535 + (65535/65536)$	FFFFFFFFh

5.1.5 u1Fixed15Number

A fixed unsigned 2-byte/16-bit quantity, which has 15 fractional bits as shown in table 5.

Table 5 — u1Fixed15Number

Number	Encoding
0	0000h
1,0	8000h
$1 + (32767/32768)$	FFFFh

5.1.6 u8Fixed8Number

A fixed unsigned 2-byte/16-bit quantity which has 8 fractional bits as shown in table 6.

Table 6 — u8Fixed8Number

Number	Encoding
0	0000h
1,0	0100h
$255 + (255/256)$	FFFFh

5.1.7 ulnt16Number

A generic unsigned 2-byte/16-bit quantity.

5.1.8 ulnt32Number

A generic unsigned 4-byte/32-bit quantity.

5.1.9 ulnt64Number

A generic unsigned 8-byte/64-bit quantity.

5.1.10 ulnt8Number

A generic unsigned 1-byte/8-bit quantity.

5.1.11 XYZNumber

A set of three fixed signed 4-byte/32-bit quantities used to encode CIE XYZ tristimulus values (which cannot be negative) where byte usage is assigned as specified in table 7. All XYZNumbers (other than those specifying luminance) shall be linearly scaled such that Y is specified over the range of 0 to 1,0.

Table 7 — XYZNumber

Byte Position	Field Length (bytes)	Content	Encoded as...
0..3	4	CIE X	s15Fixed16Number
4..7	4	CIE Y	s15Fixed16Number
8..11	4	CIE Z	s15Fixed16Number

NOTE 1 CIE specify that for reflecting and transmitting media Y should be normalized such that it has the value 100 for the perfect diffusing reflector or transmitter. In this International Standard, for reasons of coding efficiency, Y is specified such that it has the value 1 for the perfect diffusing reflector or transmitter.

NOTE 2 Signed numbers are employed for this type to accommodate negative values arising during calculations.

5.1.12 Seven-bit ASCII

Alpha-numeric values, and other input and output codes, shall conform to the American Standard Code for Information Interchange (ASCII) specified in ISO/IEC 646.

5.2 Abbreviations

ANSI	American National Standards Institute
CIE	<i>Commission Internationale de l'Éclairage</i> (International Commission on Illumination)
CLUT	Colour Lookup Table (multidimensional)
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

6 Profile Connection Space and rendering intents

6.1 Introduction

The Profile Connection Space (PCS) is the reference colour space in which colours are encoded in order to provide an interface for connecting source and destination transforms. The PCS values constitute an encoding of a CIE colorimetric specification.

Four rendering intents are specified in this International Standard - ICC-absolute colorimetric, media-relative colorimetric, perceptual and saturation. Each represents a type of colour rendering (mapping of colour values) that is useful for various imaging workflows. The colorimetric intents preserve the colorimetry of in-gamut colours at the expense of out-of-gamut colours. The mapping of out-of-gamut colours is not specified but should be consistent with the intended use of the transform. The perceptual and saturation rendering intents modify colorimetric values to account for any differences between devices, media, and viewing conditions.

The media-relative colorimetric transform is useful for colours that have already been mapped to the intended reproduction media-relative colorimetry, whereas the ICC-absolute colorimetric transform is useful for spot

colours, and when simulating one medium on another in proofing applications. However, for some proofing applications users prefer that the medium is not simulated and a media-relative rendering is preferred.

Perceptual rendering is useful for general reproduction of images, particularly pictorial or photographic-type images. Saturation rendering is useful for images which contain objects such as charts or diagrams.

The requirements for these rendering intents are given in clause 6.2 and discussed further in Annex D.

Profiles are required to contain transformations for one, or more, of these rendering intents. Which rendering intents are required, and which are optional, for the various classes of profile, is specified in clause 7.

6.2 Rendering intents

6.2.1 General

The colorimetric rendering intents operate on measurement-based colorimetric values as chromatically adapted to the PCS illuminant D50. This adaptation, when required, shall be indicated in the `chromaticAdaptationTag`. For the purposes of this International Standard chromatic adaptation should be calculated using the linear Bradford model. This recommended model is the same as the linearized CIECAM97s transformation given in CIE Publication 131 [11], when full adaptation is assumed and a negligible non-linearity in the blue channel is omitted. Details of this model are provided in Annex E.

NOTE This tag is required, whenever actual illumination sources differ from those of D50, so that original measurement values can be determined from PCS values by applying the inverse chromatic adaptation transformation, if required. This inversion is not usually a CMM function, and since the PCS values are already adapted to D50 when constructing the profiles neither the forward or inverse chromatic adaptation transforms need to be applied by the CMM in normal use of the profiles.

For the other intents transformations shall be assumed to be specified relative to the PCS illuminant D50. However, for these transformations profiles are not required to specify any chromatic adaptation that may have been employed in the calculation of the transformation data.

In transforms for the media-relative and ICC-absolute colorimetric intents, the PCS values may represent a colour rendering of the actual original captured for input profiles. Likewise for output profiles, the PCS values may be colour rendered by the output device to the actual medium. However, wherever ICC profiles are used, the PCS values resulting from such transforms shall be interpreted as the colorimetry of the original and reproduction, regardless of whether such colorimetry is the actual colorimetry.

6.2.2 Media-relative colorimetric intents

Transformations for this intent shall re-scale the in-gamut, chromatically adapted tristimulus values such that the white point of the actual medium is mapped to the PCS white point (for either input or output) as defined in clause 6.3.2.

NOTE Transforms for the media-relative colorimetric intent represent media-relative measurements of the captured original (for input profiles), or media-relative colour reproductions produced by the output device (for output profiles).

6.2.3 ICC-absolute colorimetric intent

Transformations for this intent shall leave the chromatically adapted tristimulus values of the in-gamut colours unchanged.

Profiles do not contain a separate transform for the ICC-absolute colorimetric intent. When this intent is needed, it shall be generated, as described in 6.3.2, using the `mediaWhitePointTag`, which specifies the CIE 1931 XYZ tristimulus values of the white point of the actual medium, as represented in the PCS. In practice ICC-absolute colorimetric rendering may be obtained by using the media-relative colorimetric intent transformations for the source and destination profiles and scaling the PCS values by the ratio of the destination profile `mediaWhitePointTag` to the source profile `mediaWhitePointTag`.

As specified in clause 9.2.25, for monitor profiles the mediaWhitePointTag shall be set to the PCS white point, (defined in 6.3.4.3). If chromatic adaptation is being applied when obtaining the PCS values, the adaptation shall be applied to the mediaWhitePointTag values as well. If the viewer is assumed to completely adapt to the white point of the medium for any other media the mediaWhitePointTag should be set to the PCS white point.

NOTE 1 Transforms for the ICC-absolute colorimetric intent represent measurements of the captured original relative to a hypothetical perfectly reflecting or transmitting diffuser (for input profiles), or colour reproductions produced by the output device relative to a hypothetical perfectly reflecting or transmitting diffuser (for output profiles).

NOTE 2 This definition of ICC-absolute colorimetry is sometimes called “relative colorimetry” in CIE terminology, since the data has been normalized relative to the perfect diffuser viewed under the same illumination source as the sample.

6.2.4 Perceptual intent

In perceptual transforms the PCS values represent hypothetical measurements of a colour reproduction on a reference reflective medium. By extension, for the perceptual intent, the PCS represents the appearance of that reproduction as viewed in the reference viewing environment by a human observer adapted to that environment. The exact colour rendering of the perceptual intent is vendor specific.

NOTE 1 The reference medium and viewing environment are defined in 6.3.3.

NOTE 2 The perceptual intent is useful when it is not required to exactly maintain image colorimetry (such as with natural images), and the input and output media are substantially different.

NOTE 3 When using the perceptual intent, the colour rendering to the reference medium serves to ensure that input and output profiles from different manufacturers will work reasonably well together, although the results from different combinations of profiles will likely be different due to the proprietary nature of the colour rendering contained in this intent.

6.2.5 Saturation intent

The exact gamut mapping of the saturation intent is vendor specific and involves compromises such as trading off preservation of hue in order to preserve the vividness of pure colours.

6.3 Profile Connection Space

6.3.1 Chromatic adaptation

The chromaticity of the D50 illuminant defined in ISO 3664 shall define the chromatic adaptation state associated with the PCS.

6.3.2 Colorimetric specification

The measurement parameters for the Profile Connection Space (PCS), and all other colour spaces defined in this specification, shall be based on ISO 13655. The colorimetry shall be assumed not to contain any flare or other defect caused by inadequacies in the optical system of the instrument and illumination used to make the measurements, but shall be assumed to include the surface reflection component normally associated with the prescribed measurement geometry.

The PCS colour space encodings shall be based on media-relative colorimetry in which tristimulus values normalised with respect to the illuminant and a perfect diffuser for reflecting and transmitting media are normalised to those of the media under the reference illuminant. For the perceptual rendering intent the medium for calculation of the media-relative colorimetry shall be the reference medium defined in 6.3.3. The translation from media-relative colorimetry XYZ data, XYZ_r to ICC-absolute colorimetric data, XYZ_a , is given by:

$$X_a = \left(\frac{X_{mw}}{X_i} \right) \cdot X_r \quad (1)$$

$$Y_a = \left(\frac{Y_{mw}}{Y_i} \right) \cdot Y_r \quad (2)$$

$$Z_a = \left(\frac{Z_{mw}}{Z_i} \right) \cdot Z_r \quad (3)$$

where XYZ_{mw} represents the media white point specified in the mediaWhitePointTag and XYZ_i represents the PCS illuminant white (which is D50 - $X=0,9642$, $Y=1$, $Z=0,8249$).

NOTE 1 For the perceptual rendering intent the media used for normalisation is the reference medium defined in 6.3.3.

When PCS values are encoded as CIELAB values these may be computed from the media-relative tristimulus values in the usual way (see Annex A), noting that:

$$\frac{X}{X_n} \text{ is replaced by } \frac{X_r}{X_i} \text{ (or } \frac{X_a}{X_{mw}} \text{)} \quad (4)$$

$$\frac{Y}{Y_n} \text{ is replaced by } \frac{Y_r}{Y_i} \text{ (or } \frac{Y_a}{Y_{mw}} \text{)} \quad (5)$$

$$\frac{Z}{Z_n} \text{ is replaced by } \frac{Z_r}{Z_i} \text{ (or } \frac{Z_a}{Z_{mw}} \text{)} \quad (6)$$

NOTE 2 Further explanation is provided in Annex A.

6.3.3 Reference viewing environment and medium for the perceptual rendering intent

Because perceptual rendering generally requires a gamut mapping that transforms the boundary of the input gamut to (or close to) the boundary of the gamut of the output device it is desirable that the gamut boundary of the PCS be reasonably well defined. Since the gamut is defined both by the media and viewing condition it is necessary to specify both of these in an unambiguous way. These are specified in the following:

The reference viewing environment shall be based on standard viewing condition P2, as specified for graphic arts and photography in ISO 3664, but extended as follows. It is characterized by an "average" surround, which means that the illumination of the image shall be assumed to be similar to the illumination of the rest of the environment. The surfaces immediately surrounding the image shall be assumed to be a uniform matt grey with a reflectance of 20%. The reference viewing environment shall also be assumed to have a level of viewing flare of 0,0075 (3/4%) of the luminance of the reference medium in the reference viewing environment (1,06 cd/m²). If the actual viewing environment differs from the reference viewing environment perceptual transforms must compensate for the differences in viewing environments.

NOTE 1 ISO 3664 describes the appropriate illumination level for practical appraisal of prints as 500 lux (P2), which is specified to be typical of actual home and office viewing environments. This was deemed to be most appropriate for the reference viewing environment.

The reference medium is defined as a hypothetical print on a substrate specified to have a neutral reflectance of 89%. The darkest printable colour on this medium is assumed to have a neutral reflectance of 0,30911%, which is 0,34731% of the substrate reflectance. These shall be assumed to be the white point and black point of the reference medium respectively.

NOTE 2 The reference medium therefore has a linear dynamic range of 287,9 :1 and a density range of 2,4593.

NOTE 3 The reference colour gamut defined in Annex B of ISO 12640-3 [14] has been suggested as the gamut of the perceptual rendering intent reference medium.

6.3.4 Colour space encodings for the PCS

6.3.4.1 General

The colorimetric data defined in the above clauses may be specified either as CIEXYZ or CIELAB data. When specified as CIEXYZ data it shall be encoded using 16bits/component while when specified as CIELAB data it shall be encoded as either 8 or 16 bits/component.

NOTE 1 These alternative methods are provided in order to satisfy conflicting requirements for accuracy and storage space. The profile header specifies which has been used. While supporting multiple CIE encodings increases the complexity of colour management, it provides immense flexibility in addressing different user requirements such as colour accuracy and memory footprint.

NOTE 2 It is important to understand that the PCS encodings do not represent a quantization of the connection space. The purpose of the encodings is to allow points within the space to be specified. Since the processing models benefit from interpolation between table entries, the interpolated AToB results should be used as the inputs to the BToA transforms. The AToB results should not be rounded to the nearest encoding value. (AToB and BToA transforms are defined in clauses 10.10 and 10.11)

6.3.4.2 General PCS encoding

For the CIEXYZ encoding, each component (X, Y, and Z) is encoded as a u1Fixed15Number.

The largest valid XYZ values are those of the PCS illuminant specified in the profile header. This encoding was chosen to allow for PCS illuminants that have an X or Z greater than 1,0.

NOTE 1 For a D50 illuminant, the largest valid XYZ values are [0,9642 1,0 0,8249], or [7B6Bh, 8000h, 6996h] in encoded form. Note that the PCS illuminant values are stored in s15Fixed16Number format, so they must be translated to u1Fixed15Number format to find the encoded PCS limits.

For the CIELAB PCS encodings, the L^* values have a different encoding than the a^* and b^* values. The L^* encoding is shown in table 8.

Table 8 — CIELAB L^* encoding

Value (L^*)	8-bit	16-bit
0	00h	0000h
100,0	FFh	FFFFh

The a^* and b^* encoding is shown in table 9.

Table 9 — CIELAB a^* or b^* encoding

Value (a^* or b^*)	8-bit	16-bit
-128,0	00h	0000h
0	80h	8080h
127,0	FFh	FFFFh

NOTE 2 This is not "two's complement" encoding, but a linear scaling after an offset of 128. This encoding was chosen to prevent discontinuities in CLUTs when going from negative to positive values.

NOTE 3 It is possible to convert between the 8-bit and 16-bit encodings by multiplying or dividing by 257. (See A.4.)

NOTE 4 Both the lut16Type and the namedColor2Type tag types (and ONLY those tag types) use a legacy 16 bit encoding of L*, a* and b* which is retained for backwards compatibility with an earlier profile version (version 2). To avoid confusion this encoding is specified in clause 10.8 "Lut16Type".

6.3.4.3 PCS encodings for white and black

In transforms for the media-relative colorimetric, perceptual, and saturation rendering intents (all intents other than ICC-absolute colorimetric), the white point of the actual medium, and the white point of the reference medium, are represented in PCS XYZ and PCS Lab formats as shown in table 10.

Table 10 — White point encodings

Component	Value	8-bit Encoding	16-bit Encoding	Component	Value	Encoding
L*	100	FFh	FFFFh	X	0,9642	7B6Bh
a*	0	80h	8080h	Y	1,0000	8000h
b*	0	80h	8080h	Z	0,8249	6996h

In transforms for the media-relative colorimetric intent the perfect absorber (a theoretical medium that reflects absolutely no light) is represented in PCS XYZ and PCS L*a*b* formats as shown in table 11. Other reflectance values are mapped linearly to PCS XYZ.

Table 11 — Perfect absorber encodings

Component	Value	8-bit Encoding	16-bit Encoding	Component	Value	Encoding
L*	0	00h	0000h	X	0,0	0000h
a*	0	80h	8080h	Y	0,0	0000h
b*	0	80h	8080h	Z	0,0	0000h

In transforms for the perceptual and saturation intents the black point of the reference medium is represented in PCS XYZ and PCS Lab formats as shown in table 12. This is here called the PCS perceptual black point.

Table 12 — Black point encoding of reference media

Component	Value	8-bit Encoding	16-bit Encoding	Component	Value	Encoding
L*	3,1373	08h	0808h	X	0,003357	006Eh
a*	0	80h	8080h	Y	0,003479	0072h
b*	0	80h	8080h	Z	0,002869	005Eh

NOTE 1 Due to limited numerical precision, Y encoded as 114 (0072h) does not exactly match L* encoded as 8 (08h).

NOTE 2 Perceptual transforms developed to meet ICC specifications prior to version 4.0 frequently use zero to represent the black point, and thus do not conform to this specification. Such transforms should be adjusted by scaling the black point as needed. The white point should remain unchanged and all other values should be mapped linearly in XYZ. The following equations can be used for the adjustment of such a transform to the above PCS encoding.

$$X_p = X_t \cdot \left(1 - \frac{X_b}{X_i} \right) + X_b \quad (7)$$

$$Y_p = Y_t \cdot \left(1 - \frac{Y_b}{Y_i}\right) + Y_b \quad (8)$$

$$Z_p = Z_t \cdot \left(1 - \frac{Z_b}{Z_i}\right) + Z_b \quad (9)$$

where: X_t, Y_t, Z_t = original PCS XYZ value in the transform
 X_b, Y_b, Z_b = XYZ values for the PCS perceptual black point ($X = 0,003357, Y = 0,003479, Z = 0,002869$)
 X_i, Y_i, Z_i = XYZ values of the PCS white point ($X = 0,9642, Y = 1,0000, Z = 0,8249$)
 X_p, Y_p, Z_p = the adjusted PCS XYZ value

6.4 Converting between CIE XYZ and CIE LAB encodings

Conversions between the CIE XYZ and CIE LAB encodings shall use the equations specified in ISO 13655 (see A.3 in Annex A). Any colours in the PCS XYZ encoding range that are outside of the PCS LAB encoding range shall be clipped on a per-component basis to the outside limits of the range of PCS LAB when transforming from XYZ into LAB. Conversely, any colours that occur in the PCS LAB encoding range that are outside of the encoding range of PCS XYZ shall be clipped on a per-component basis to the PCS XYZ range when transforming from LAB into XYZ.

7 Profile requirements

7.1 General

An ICC profile shall include the following elements, in the order shown, as a single file.

- a) a 128-byte profile header as defined in 7.2,
- b) a profile tag table as defined in 7.3, and
- c) profile tagged element data as defined in 7.4.

This is illustrated in Figure 6.

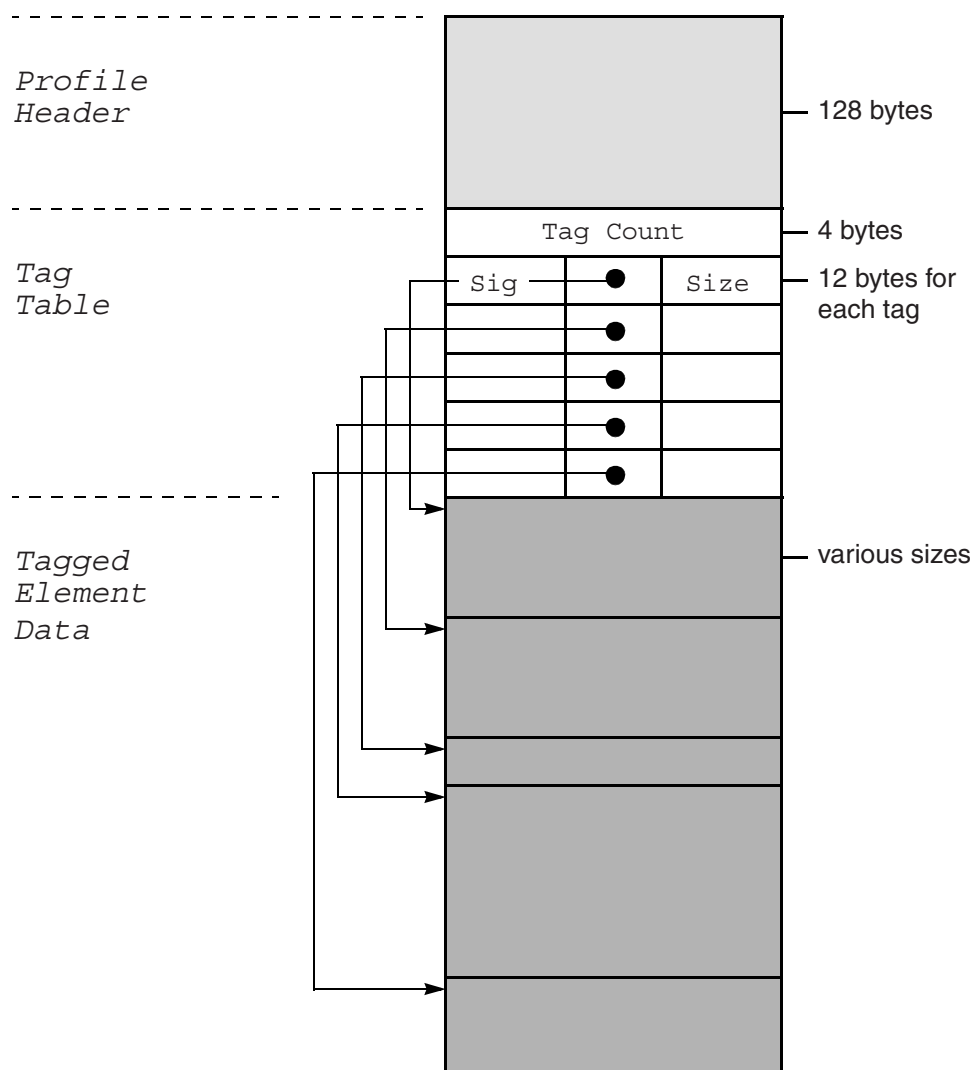


Figure 6 — Profile header structure

The required tags for each profile type are tabulated in clause 8. The definition of all publicly available tags and their signatures is contained in clause 9 along with the allowed tag types for each tag. Tag types are defined in clause 10.

Within the profile structure:

- d) All profile data shall be encoded as big-endian,
- e) The first set of tagged element data shall immediately follow the tag table,
- f) All tagged element data, including the last, shall be padded by no more than three following pad bytes to reach a 4-byte boundary, and
- g) All pad bytes shall be NULL (ISO 646, character 0/0).

NOTE 1 This implies that the length must be a multiple of four.

NOTE 2 The above restrictions result in two key benefits. First, the likelihood of two profiles which contain the same tag data, yet have different checksum values, is reduced. Second, all profiles are reduced to a minimum size.

7.2 Profile header

7.2.1 General requirements

The profile header provides the necessary information to allow a receiving system to properly search and sort ICC profiles. The profile header is 128 bytes in length and contains 18 fields. Table 13 gives the byte position, field length, and content of each element in the profile header. The encoding of the field contents shall be as defined in 7.2.2 through 7.2.19.

NOTE 1 Having a fixed length header allows for performance enhancements in profile searching and sorting applications.

NOTE 2 For colour space conversion and abstract profiles (see clauses 8.7 and 8.8) some of these fields are not relevant and may be set to zero..

Table 13 — Profile header fields

Byte Position	Field Length (bytes)	Field Contents	Encoded as
0..3	4	Profile size	UInt32Number
4..7	4	Preferred CMM Type	See 7.2.3
8..11	4	Profile version number	See 7.2.4
12..15	4	Profile/Device Class	See 7.2.5
16..19	4	Colour space of data (possibly a derived space) [i.e. “the canonical input space”]	See 7.2.6
20..23	4	Profile Connection Space (PCS) [i.e. “the canonical output space”]	See 7.2.7
24..35	12	Date and time this profile was first created	dateTimeNumber
36..39	4	‘acsp’ (61637370h) profile file signature	See 7.2.9
40..43	4	Primary Platform signature	See 7.2.10
44..47	4	Profile flags to indicate various options for the CMM such as distributed processing and caching options	See 7.2.11
48..51	4	Device manufacturer of the device for which this profile is created	See 7.2.12
52..55	4	Device model of the device for which this profile is created	See 7.2.13
56..63	8	Device attributes unique to the particular device setup such as media type	See 7.2.14
64..67	4	Rendering Intent	See 7.2.15
68..79	12	The XYZ values of the illuminant of the Profile Connection Space. This must correspond to D50.	XYZNumber
80..83	4	Profile Creator signature	See 7.2.17
84..99	16	Profile ID	See 7.2.18
100..127	28	Bytes reserved for future expansion - must be set to zero (3/0 of ISO 646)	

7.2.2 Profile size field (Bytes 0 to 3)

The value in the profile size field shall be the exact size obtained by combining the profile header, the tag table, and the tagged element data, including the pad bytes for the last tag. It shall be encoded as a uint32Number.

7.2.3 Preferred CMM type field (Bytes 4 to 7)

This field may be used to identify the preferred CMM to be used. If used, it shall match a CMM type signature registered in the ICC registry (see clause 2). If no preferred CMM is identified, this field shall be set to zero (00000000h).

7.2.4 Profile version field (Bytes 8 to 11)

The profile version with which the profile is compliant shall be encoded as binary-coded decimal in the profile version field. The first byte (byte 8) shall identify the major revision and byte 9 shall identify the minor revision and bug fix revision in each 4-bit half of the byte. Bytes 10 and 11 are reserved and shall be set to zero. The major and minor revision are set by the International Color Consortium. The profile version number consistent with this International Standard is "4.2.0.0" (encoded as 04200000h).

NOTE A major revision will occur only when changes made to the specification require that both CMMs and profile generating software be upgraded in order to correctly use or produce profiles conforming to the revised specification. A minor revision will occur when any changes to the specification are such that existing CMMs can still correctly process a new profile. For example, adding a required tag would require a major revision to the specification, whereas adding an optional tag would only require a minor revision.

7.2.5 Profile/device class field (Bytes 12 to 15)

This field shall contain one of the profile class signatures shown in Table 14.

There are three basic classes of device profiles: Input, Display and Output profiles. In addition to the three basic device profile classes, four additional colour processing profiles are defined. These profiles provide a standard implementation for use by the CMM in general colour processing, or for the convenience of CMMs which may use these types to store calculated transforms. These four additional profile classes are DeviceLink, ColorSpace Conversion, Abstract, and Named colour profiles.

Table 14 — Profile classes

Profile Class	Signature	Hex Encoding
Input Device profile	'scnr'	73636E72h
Display Device profile	'mntr'	6D6E7472h
Output Device profile	'ptr'	70727472h
DeviceLink profile	'link'	6C696E6Bh
ColorSpace Conversion profile	'spac'	73706163h
Abstract profile	'abst'	61627374h
Named colour profile	'nmcl'	6E6D636Ch

7.2.6 Data colour space field (Bytes 16 to 20)

This field shall contain the signature of the data colour space used. The names and signatures of the allowed data colour spaces are shown in Table 15. Signatures are left justified.

Table 15 — Data colour spaces

Colour Space	Signature	Hex Encoding
XYZData	'XYZ '	58595A20h
labData	'Lab '	4C616220h
luvData	'Luv '	4C757620h
YCbCrData	'YCbCr'	59436272h
YxyData	'Yxy '	59787920h
rgbData	'RGB '	52474220h
grayData	'GRAY'	47524159h
hsvData	'HSV '	48535620h
hlsData	'HLS '	484C5320h
cmykData	'CMYK'	434D594Bh
cmyData	'CMY '	434D5920h
2colourData	'2CLR'	32434C52h
3colourData (if not listed above)	'3CLR'	33434C52h
4colourData (if not listed above)	'4CLR'	34434C52h
5colourData	'5CLR'	35434C52h
6colourData	'6CLR'	36434C52h
7colourData	'7CLR'	37434C52h
8colourData	'8CLR'	38434C52h
9colourData	'9CLR'	39434C52h
10colourData	'ACLRL'	41434C52h
11colourData	'BCLR'	42434C52h
12colourData	'CCLR'	43434C52h
13colourData	'DCLR'	44434C52h
14colourData	'ECLR'	45434C52h
15colourData	'FCLR'	46434C52h

7.2.7 Profile Connection Space field (Bytes 20 to 23)

For all profile classes (see Table 14), other than a DeviceLink profile, the Profile Connection Space shall be either XYZData or labData and the signature shall be as defined in Table 15. When the profile/device class is a DeviceLink profile, the value of the Profile Connection Space shall be the appropriate colour space from Table 15.

7.2.8 Date and time field (Bytes 24 to 35)

This header field shall contain the date and time that the profile was first created, encoded as a dateTimeNumber.

7.2.9 Profile file signature field (Bytes 36 to 39)

The profile file signature field shall contain the value “acsp” (61637379h) as a profile file signature.

7.2.10 Primary platform field (Bytes 40 to 43)

This field may be used to identify the primary platform/operating system framework for which the profile was created. The primary platforms that have been identified, and the signatures that shall be used are shown in Table 16. If there is no primary platform identified, this field shall be set to zero (00000000h).

Table 16 — Primary platforms

Primary Platform	Signature	Hex Encoding
Apple Computer, Inc.	‘APPL’	4150504Ch
Microsoft Corporation	‘MSFT’	4D534654h
Silicon Graphics, Inc.	‘SGI ’	53474920h
Sun Microsystems, Inc.	‘SUNW’	53554E57h

7.2.11 Profile flags (Bytes 44 to 47)

The profile flags field shall contain flags to indicate various hints for the CMM such as distributed processing and caching options. The least-significant 16 bits are reserved for the ICC. Flags in bit positions 0 and 1 shall be used as indicated in Table 17.

Table 17 — Profile flags

Bit Position	Field Length (bits)	Field Contents
0	1	Embedded Profile (0 if not embedded, 1 if embedded in file)
1	1	Profile cannot be used independently from the embedded colour data (set to 1 if true, 0 if false)

7.2.12 Device manufacturer field (Bytes 48 to 51)

This field may be used to identify a device manufacturer. If used the signature shall match the signature contained in the appropriate section of the ICC signature registry found at www.color.org (see clause 2). If not used this field shall be set to zero (00000000h).

7.2.13 Device model field (Bytes 52 to 55)

This field may be used to identify a device model. If used the signature shall match the signature contained in the appropriate section of the ICC signature registry found at www.color.org (see clause 2). If not used this field shall be set to zero (00000000h).

7.2.14 Device attributes field (Bytes 56 to 63)

The device attributes field shall contain flags used to identify attributes unique to the particular device setup for which the profile is applicable. The least-significant 32 bits of this 64-bit value are reserved for the ICC. Flags in bit positions 0 through 3 shall be used as shown in table 18.

Table 18 — Device attributes

Bit Position	Field Length (bits)	Attribute
0	1	Reflective (0) or Transparency (1)
1	1	Glossy (0) or Matte (1)
2	1	Media polarity - Positive (0) or Negative (1)
3	1	Colour media (0), Black & white media (1)

NOTE Notice that bits 0, 1, 2, and 3 describe the media, not the device. For example, a profile for a colour scanner that has been loaded with black & white film will have bit 3 set on, regardless of the value in the data colour space field (see 7.2.6). If the media is not inherently "colour" or "black & white" (such as the paper in an inkjet printer), the reproduction takes on the property of the device. Thus, an inkjet printer loaded with a colour ink cartridge can be thought to have "colour" media.

7.2.15 Rendering intent field (Bytes 64 to 67)

The rendering intent field shall specify the rendering intent which should be used (or, in the case of a DeviceLink profile, was used) when this profile is (was) combined with another profile. In a sequence of more than two profiles, it applies to the combination of this profile and the next profile in the sequence and not to the entire sequence. Typically, the user or application will set the rendering intent dynamically at runtime or embedding time. Therefore, this flag may not have any meaning until the profile is used in some context, e.g in a DeviceLink or an embedded source profile.

The field is a uint32Number in which the least-significant 16 bits shall be used to encode the rendering intent. The most significant 16 bits shall be set to zero (0000h).

The defined rendering intents are: perceptual, media-relative colorimetric, saturation and ICC-absolute colorimetric. These shall be identified using the values shown in Table 19.

Table 19 — Rendering intents

Rendering Intent	Value
Perceptual	0
Media-Relative Colorimetric	1
Saturation	2
ICC-Absolute Colorimetric	3

7.2.16 Profile Connection Space illuminant field (Bytes 68 to 79)

The Profile Connection Space illuminant field shall contain the CIEXYZ values of the illuminant used for the Profile Connection Space encoded as an XYZNumber. At present the only illuminant permitted for the Profile Connection Space is D50 (where X=0,9642; Y=1,0 and Z=0,8249). See Annex A for further details.