

Interoperability Conformance Specification: colorimetricEncoding – Part 1: basic colorimetric encoding

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Foreword

This document has been prepared following the [ICC Intellectual Property Policy](#). This policy is based on the ITU-T/ITU-R/ISO/IEC [Guidelines for Implementation of the Common Patent Policy](#) (23 April 2012), with [interpretations and clarifications](#) to make it specific to ICC. A [Patent Statement and Licensing Declaration form](#) is available.

ICC Interoperability Conformance Specifications, of which this document is an example, may be submitted to the competent ISO Technical Committee for consideration and development as an ISO document. If so, this foreword is to be replaced by the appropriate wording supplied by ISO.

Introduction

ISO 20677-1 defines specifications that provide a platform for defining extended (iccMAX) colour management profiles and systems for various colour workflow domains. It provides a platform for which domain specific specifications can be defined that make use of iccMAX extensions to the existing cross-platform profile format of ISO 15076-1. Thus there is greater flexibility for defining colour transforms and profile connection spaces to meet needs that cannot easily be met with ISO 15076-1. It is not envisioned that all colour management systems that use ISO 20677-1 will implement all the features or capabilities it specifies. Requirements specifying restrictions to iccMAX that apply to a particular workflow are defined in workflow domain specifications known as Interoperability Conformance Specifications, of which this document is one example. Additionally, for some domain specific workflows it is envisioned that workflows will connect both to profiles defined by ISO 20677-1 (iccMAX) and those defined by ISO 15076-1.

An Interoperability Conformance Specification (ICS) is approved and registered by the International Color Consortium (ICC). It defines minimum structural and operational requirements for writing and reading ICC profiles in order to address a specific problem and/or functionality that cannot readily be handled using the profile format defined by ISO 15076-1. An ICS document essentially defines restrictions to ISO 20677-1 for a specific use case.

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1 Scope

All parts of this specification define scenario requirements and restrictions to profiles based on ISO 20677-1 for the purpose of defining relationships between colorimetric device encodings and a colorimetric Profile Connection Space.

The particular sub-set of the tags defined in ISO 20677-1 that are required to be present is defined, together with any optional tags that are permitted. The connections between profiles are described, and the processing elements that the CMM is required to support are identified.

This part of this ICS defines transforms with limited processing element support thus enabling colorimetric encoding workflows with less implementation requirements.

Other parts of this ICS define transforms with more extended processing element support for more complicated modeling and color management situations.

2 Normative references

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

ISO 20677-1:20##, *Image technology colour management — Extensions to architecture, profile format, and data structure: iccMAX*

NOTE: The most recent version of the iccMAX specification is available on the ICC web site [2].

3 Terms and definitions

All terms and definitions relevant to this document are provided in ISO 20677.

3.1 observing conditions

the observer's colour matching functions and illuminant associated with the spectralViewingConditionsTag of the Profile Connection Condition (PCC) used to connect the profile to the PCS

4 Use case

4.1 Domain

Profiles and workflows conforming to this ICS shall apply to the domain of General (i.e. the domain of application is unspecified).

4.2 Intended use

The intended use of this specification is to define workflows in which colorimetric data encoding needs to be defined along with associated observer and illuminant. Custom observer and illuminant information are provided (in the spectralViewingConditionsTag) along with transforms to convert between standard (D50 for 2-degree standard observer) and custom observing conditions (via the customToStandardPccTag and the standardToCustomPccTag).

4.3 Restrictions

ISO 20677-1 provides full details of the requirements for iccMAX profiles. This document defines a set of restrictions which apply to profiles created for the specific use case described above. Such restrictions include the sub-set of tags from ISO 20677-1 which are permitted in profiles conforming to this document.

5 Workflow

5.1 Profile sub-classes

A supporting CMM shall support the sub-classes of the profile classes identified in Table 1 for conformance with this ICS. All profile classes are defined in ISO 20677-1.

Table 1. Sub-classes of profile classes defined by this ICS

Profile	Profile class	Sub-class Identifier	Class signature	Sub-class signature
	colorSpace	colorimetricEncoding	'spac' (73706163h)	'pcc' (70636320h)

5.2 Connection Scenarios

5.2.1 General

A 'pcc' colorimetricEncoding profile connects 3 input channels to a colorimetric Profile Connection Space. It can be used as either a source profile, a destination profile, or as a PCC override.

5.2.2 Profiles for ICS workflow scenarios

Table 2 provides overview information about additional profiles that are used to describe several profile connection scenarios conforming to this ICS.

Table 2. Additional profiles referenced in workflow scenarios defined by this ICS

Profile	Description
	Profile conforming to ISO 20677-1 or ISO 15076-1 containing (a) colorimetric transform(s) with CMM configured to use a colorimetric transform type
	Profile conforming to ISO 20677-1 containing Profile Connection Condition tags (spectralViewingConditionsTag, customToStandardPccTag, standardToCustomPccTag)
	Profile conforming to ISO 20677-1 or ISO 15076-1
	Profile conforming to ISO 20677-1 utilizing Profile Connection Conditions to go into or out of the PCS

5.2.3 Workflow Scenarios

5.2.3.1 General

The following sections document scenarios that general purpose CMMs should implement to conform to this ICS. For each scenario the profile sequence is depicted along with associated CMM control parameters that select between workflow scenarios.

Note: It is recognized that specialized CMMs may choose to not implement all the scenarios in these sections due to particular configuration or requirements of their supporting application(s).

5.2.3.2 Scenario A.1: Connecting a colorimetricEncoding profile as source to a destination profile with a colorimetric PCS

**Figure 1 – Profile sequence for Scenario A.1**

In this scenario a profile conforming to this ICS (profile E from Table 1) is used as a source profile with a colorimetric PCS connected to an arbitrary profile (profile C from Table 2) that is set up to use a colorimetric PCS. The transform type for profile E is “colorimetric” indicating that the transform from an AToBxTag from profile E is used to transform device values to a colorimetric PCS.

A CMM that supports this scenario shall be configured to process profiles in the sequence shown in Figure 1 with the associated CMM control parameters as identified in Table 3 and described by ISO 20677:2019 Annex K.

Table 3. CMM control parameters for Scenario A.1

Profile	CMM Control Parameter	Value
	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	None
	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	Any

In this scenario either the observing conditions in profile E shall be for the standard 2-degree observer under D50 or they shall match those of profile C.

The resulting colorimetry from the transform in Profile E shall be transformed and applied as needed according to the requirement (ICS or specification) associated with profile C.

5.2.3.3 Scenario B.1: Connecting a colorimetricEncoding profile as source using a PCC override to a destination profile with a colorimetric PCS

**Figure 2 – Profile sequence for Scenario B.1**

In this scenario a profile conforming to this ICS (profile E from Table 1) is used as a source profile with a colorimetric PCS connected to an arbitrary profile (profile C from Table 2) that is set up to use a colorimetric PCS. The transform type for profile E is “colorimetric” indicating that the transform from an AToBxTag from profile E is used to transform device values to a colorimetric PCS.

A CMM that supports this scenario shall be configured to process profiles in the sequence shown in Figure 2 with the associated CMM control parameters as identified in Table 4 and described by ISO 20677:2019 Annex K.

Table 4. CMM control parameters for Scenario B.1

Profile	CMM Control Parameter	Value
	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	
	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	Any

If the observing conditions of profile E do not match those of profile C then the transform from the customToStandardPccTag in profile P (from Table 2) is applied resulting in standard colorimetry in the PCS. The resulting colorimetry shall then transformed and applied as needed according to the requirements (ICS or specification) associated with profile C.

5.2.3.4 Scenario C.1: Connecting source profile to a colorimetricEncoding profile as destination

**Figure 3 – Profile sequence for Scenario C.1**

In this scenario an arbitrary profile (profile 1 from Table 2) is connected to a profile conforming to this ICS (profile E from Table 1) used as a destination profile.

A CMM that supports this scenario shall be configured to process profiles in the sequence shown in Figure 3 with the associated CMM control parameters as identified in Table 5 and described by ISO 20677:2019 Annex K.

Table 5. CMM control parameters for Scenario C.1

Profile	CMM Control Parameter	Value
	Rendering Intent	Any
	Transform Type	Any
	PCC Override	Any
	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	None

Device values shall first be transformed to a colorimetric PCS according to the requirements (ICS or specification) associated with profile 1.

If the observing conditions for profile E do not match those of the PCS resulting from applying profile 1 and the observing conditions for profile E are not the same as the 2-degree observer under D50 then the transform in the standardToCustomPccTag from profile E shall be applied.

The resulting colorimetry shall then be transformed by a BToAxTag from profile E (since it is using the colorimetric transform type).

5.2.3.5 Scenario D.1: Connecting source profile to a colorimetricEncoding profile as destination using a PCC override



Figure 4 – Profile sequence for Scenario D.1

In this scenario an arbitrary profile (profile 1 from Table 2) is connected to a profile conforming to this ICS (profile E from Table 1) used as a destination profile.

A CMM that supports this scenario shall be configured to process profiles in the sequence shown in Figure 4 with the associated CMM control parameters as identified in Table 6 and described by ISO 20677:2019 Annex K.

Table 6. CMM control parameters Scenario D.1

Profile	CMM Control Parameter	Value
1	Rendering Intent	Any
	Transform Type	Any
	PCC Override	Any
E	Rendering Intent	Any
	Transform Type	Colorimetric
	PCC Override	P

Device values shall first be transformed to a colorimetric PCS according to the requirements (ICS or specification) associated with profile 1.

If the observing conditions for profile E do not match those of the PCS resulting from applying profile 1 and the observing conditions for profile E are not the same as the 2-degree observer under D50 then the transform in the standardToCustomPccTag from profile P (from Table 2) is applied (as it provides the PCC override).

The resulting colorimetry shall then be transformed by a BToAxTag from profile E (since it is using the colorimetric transform type).

5.2.3.6 Scenario E.1: Using a colorimetricEncoding profile as a PCC override

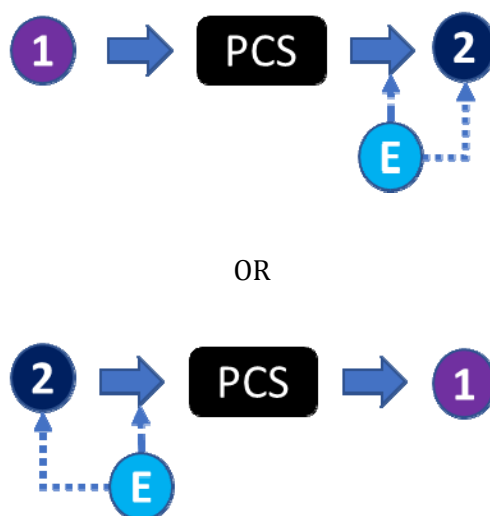


Figure 5 – Profile sequences for Scenario E.1

In this scenario the profile connection conditions of a profile conforming to this specification (profile E from Table 1) are used as a PCC override of an arbitrary profile 2 (from Table 2). Profile 2 may be used as either an input or output profile when connected to some other arbitrary profile (profile 1 from Table 2).

The observing conditions from profile E may be used as part of the application of the transform (via processing elements that use a PCC observer or illuminant to perform the transform of PCS conversion/adjustment as required for profile 2. Additionally, the transform from the standardToCustomPccTag or customToStandardPccTag of profile E shall be applied as part of the PCS conversion/adjustment for profile 2 when the PCS specified in the header of profile E is not the standard D50 PCS and does not match the PCS of Profile 1.

A CMM that supports this scenario shall be configured to process profiles in one of the sequences shown in Figure 5 with the associated CMM control parameters as identified in Table 7 and described by ISO 20677:2019 Annex K.

Table 7. CMM control parameters Scenario E.1

Profile	CMM Control Parameter	Value
1	Rendering Intent:	Any
	Transform Type:	Any
	PCC Override:	Any
2	Rendering Intent:	Any
	Transform Type:	Any
	PCC Override:	E

In this scenario all other transforms of profile E shall be ignored.

5.3 Other scenario implementation details

Where CMMs support the application of abstract profiles they should also provide support for applying abstract class profiles as part of additional PCS processing associated with the scenarios in section 5.2.

6 Sub-class Profile Requirements

6.1 General

Requirements for iccMAX profiles conforming to this ICS document are listed here. ICC v4 profiles referred to in Section 5 above shall conform to ISO 15076-1.

6.2 Requirements

The requirements for the colorimetricEncoding sub-class of colorSpace class profiles are shown below.

The encoding of the profile header shall be as defined in ISO 20677-1, with the specific requirements shown in Table .

Table 8. Header requirements

Header field	Required content
Profile class	'spac' (73706163h)
Profile subclass	'pcc' (70636320h)
Profile subclass major version	1
Profile subclass minor version	0
Profile flags	0
Device attributes	0 or 1
Data colour space	'XYZ'(58595a20h) or 'Lab'(4c616220h) matching signature of colorimetric PCS
MCS	0
Colorimetric PCS	'XYZ' (58595a20h) or 'Lab' (4c616220h) matching signature of data colour space
Spectral PCS	0
Spectral PCS range	0
Bispectral PCS	0

Full details of the encoding of the header fields in Table 8 are given in ISO 20677-1.

6.2.1 Required tags

In addition to the common requirements defined in 8.2 of ISO 20677-1, profiles shall contain the tags listed in Table .

Table 9. Required tags

Tag name	Signature	Required content
AToB1Tag	'A2B1'	LutAToBType or multiProcessElementType using any combination of curveSetElement, matrixElement, CLUTEIment, extendedCCLUTEIment, and tintArrayElement
BToA1Tag	'B2A1'	LutBToAType or multiProcessElementType using any combination of curveSetElement, matrixElement, clutElment, extendedClutElement, and tintArrayElement
customToStandardPccTag	'c2sp'	multiProcessElementType containing a single 3x3 matrix element
standardToCustomPccTag	's2cp'	multiProcessElementType containing a single 3x3 matrix element
spectralViewingConditionsTag	'svc'	Structure defining observer, illuminant and (optionally) surround

The encoding of the tags listed in Table 9 shall be as defined in ISO 20677-1.

Any additional processing elements shall not be present.

6.2.2 Example

The profiles Lab-float-D65_2deg-Part1.icc, Lab-int-D65_2deg-Part1.icc, XYZ-float-D65_2deg-Part1.icc, and Lab-int-D65_2deg-Part1.icc are encoded according to the requirements of this ICS document and are available in the ReflccMax-Testing suite v.2.1.17 [3].

NOTE XML representations of the example profiles are also provided in the ReflccMax-Testing suite.

7 Conformance

A profile shall be considered to be in conformance with this ICS document if it meets the following conditions:

- The profile connects to the channels specified in section 5.
- The profile header includes the required content from Table 8.
- All required tags listed in Table 9 are present in the profile.
- The profile structure and all tags conform to ISO 20677-1.

A CMM shall be considered to be in complete conformance with this ICS if it meets the following conditions:

- The CMM can parse profiles that conform to this ICS
- The CMM supports and is capable of processing the channels specified in section 5 and any other profiles listed in Table 2 in the scenarios described in section 5.
- The CMM is able to process the tags listed in Table 9.
- When processing a profile conforming to this ICS, the CMM produces results that are a close approximation to those produced by the iccMAX Reference Implementation [3].

Bibliography

- [1] ISO 20677-1:20##, *Image technology colour management — Extensions to architecture, profile format, and data structure*
- [2] iccMAX <http://www.color.org/iccmax/>
- [3] iccMAX Reference Implementation <http://www.color.org/iccmax/index.xalter#reficcmax>