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INTERNATIONAL STANDARD

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colour inside

Multimedia systems and equipment – Colour measurement and management – Part 12-1: Metadata for identification of colour gamut (Gamut ID)

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Systèmes et appareils multimédia – Mesure et gestion de la couleur – Partie 12-1: Métadonnées d'identification des gammes de couleurs (Gamut ID)

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MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

Part 12-1: Metadata for identification of colour gamut (Gamut ID)

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This bilingual version (2011-12) corresponds to the monolingual English version, published in 2011-01.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/1757/FDIS	100/1776/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The French version of this standard has not been voted upon.

A list of alll parts of the IEC 61966 series, published under the general title *Multimedia systems and equipment – Colour measurement and management*, can be found on the IEC website.

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INTRODUCTION

New technologies in capturing and displaying wide-gamut colour images enable a new market of wide-gamut video colour content creation. Recent video standards for wide gamut colour space encoding such as IEC 61966-2-4 (xvYCC) were established in order to be able to distribute content with a colour gamut that is extended with respect to classical colour gamuts such as defined by colorimetry standards ITU-R BT.601 (standard definition television) and ITU-R BT.709 (high definition television). With the increasing popularity of wide gamut and high dynamic range content and displays, the variety of colour gamuts of displays is expected to increase. This issue can be an obstacle for adopting wide-gamut video colour content in professional content creation since the compatibility of the content to the employed displays as well as the compatibility among different displays is not ensured. The term display includes here any video colour reproduction equipment, such as direct view displays and projectors. Thanks to improvements of technology, the variety of colour gamut and colour reproduction capacities of displays increases while the colour gamut and the colour encoding rules of existing colour space encoding standards are fixed.

To address this issue, the IEC standard Gamut ID (IEC 61966-12-1) specifies a colour gamut metadata scheme for video systems including information for colour reproduction. This metadata can amend a video content or a display. More specifically, improvements can be achieved if the wide-gamut colour content is created with the knowledge of the display colour gamut as well as if the colour reproduction in the display is done with the knowledge of the colour gamut of the pictorial content.

This standard enables video systems defining their own colour gamut. This standard defines necessary metadata that allows managing inhomogeneous video systems with different colour gamuts. This standard generalizes existing colour space encoding standards having a fixed colour gamut.

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MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

Part 12-1: Metadata for identification of colour gamut (Gamut ID)

1 Scope

This part of IEC 61966 defines the colour gamut metadata scheme for video systems and similar applications.

The metadata can be associated with wide gamut video colour content or to a piece of equipment to display the content.

When associated with content, the colour gamut metadata defines the gamut for which the content was created. It can be used by the display for controlled colour reproduction even if the display's colour gamut is different from that of the content.

When associated with a display, the colour gamut metadata defines the display colour gamut. It can be used during content creation to enable improved colour reproduction.

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The colour gamut metadata may cover associated colour encoding information, which includes all information required for a controlled colour reproduction, when such information is not provided by the colour encoding specification.

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The colour gamut metadata scheme provides scalable solutions. For example, more flexible solutions will be used for the professional use, while much simpler solutions will be used for consumer use with easier product implementation.

This part of IEC 61966 only defines the colour gamut metadata scheme. Vendor-specific solutions for creation and end-use of this metadata are allowed.

2 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.

IEC 60050(845):1987, *International electrochnical vocabulary – Chapter 845: Lighting*

IEC 61966-2-4:2006, *Multimedia systems and equipment – Colour measurement and management – Part 2-4: Colour management – Extended-gamut YCC colour space for video applications – xvYCC*

ISO 15076-1:2005 *Image technology colour management – Architecture, profile format and data structure – Part 1: Based on ICC.1:2004-10*

ISO 22028-1:2004, *Photography and graphic technology – Extended colour encodings for digital image storage, manipulation and interchange – Part 1: Architecture and requirements*

ITU-R BT.709-5:2002, *Parameter values for the HDTV standards for production and international programme exchange*

CIE 15:2004, Colorimetry

SMPTE 274M:2005, *SMPTE Standard for Television - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates*

3 Terms and definitions

For the purposes of this document, the following terms and definitions as well as the terms and definitions of colour space, illuminance, luminance, tristimulus, and other related lighting terms of IEC 60050(845) apply.

3.1
content
video content in production, post-production or consumption

3.2
gamut
a solid in a colour space

3.3
gamut boundary description
description of the boundary of a colour gamut

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3.4
radiometrically-linear colour space coordinates
colour space coordinates that are linear with respect to image radiance

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4 Abbreviations

GBD	Gamut Boundary Description
LSB	Least Significant Bit
MSB	Most Significant Bit
GI	Gamut Instance
GH	Gamut Hull
GC	Gamut Component

5 Overview

This standard specifies metadata called “Gamut ID metadata” providing information on an actual colour gamut.

The Gamut ID metadata contains four parts and its format is summarized in Table 1.

Table 1 – Format of Gamut ID metadata

Byte # hex	Metadata content
0h0000	Header of Gamut ID metadata
ID_G	Description of gamut geometry
ID_E	Description of colour reproduction

Clause 6 specifies the header of Gamut ID metadata.

Clauses 7 and 8 specify the description of gamut geometry that corresponds to one of three profiles as listed below:

- full profile;
- medium profile;
- simple profile.

Clause 7 specifies the full profile of the description of gamut geometry. The medium and simple profiles are specified in Clause 8.

Clause 9 specifies the description of colour reproduction.

6 Header of Gamut ID metadata

The Gamut ID metadata starts with the header shown in Table 2.

Table 2 – Header of Gamut ID metadata

Byte # hex	**Size** bytes	**Sym-bols**	**Description**								**Values**
			7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
00	1	N, P	R	ID_PROFILE		ID_PRECISION		ID_GBD_SPACE			R = reserved = 0b0 (1bit) ID_PFOFILE (2 bits): 0b00: Full profile 0b01: Medium profile 0b10: Simple profile 0b11: Reserved ID_PRECISION (2 bits): 0b00: 8 bits 0b01: 10 bits 0b10: 12 bits 0b11: Reserved ID_GBD_SPACE (3bits): 0b000: ITU-R BT.709 RGB 0b001: xvYCC-601 (IEC 61966-2-4 -SD) YCC 0b010: xvYCC-709 (IEC 61966-2-4 -HD) YCC 0b011: XYZ (see below) 0b100: Reserved 0b101: Reserved 0b110: Reserved 0b111: Reserved
01	2	ID_G	Byte # of start of the description of gamut geometry								[0h0009;0hFFFF]
03	2	ID_E	Byte # of start of the description of colour reproduction								[0;0hFFFF]
05	2		Reserved. Shall be zero.								0h0000
07	2		Reserved. Shall be zero.								0h0000

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ID_PROFILE indicates the profile of the Gamut ID metadata and shall be one of

- 0b00: Full profile,
- 0b01:Medium profile,
- 0b11: Simple profile.

ID_GBD_SPACE indicates the colour space and the colour space encoding for colour vertices in the description of gamut geometry and shall be one of

- 0b000: ITU-R BT.709, RGB space, encoding according to SMPTE 274M,
- 0b001: xvYCC-601, YCbCr space, encoding according to IEC 61966-2-4 – SD,
- 0b010: xvYCC-709, YCbCr space, encoding according to IEC 61966-2-4 – HD,
- 0b011: XYZ; encoding shall use the XYZNumber format of ICC profiles specified in ISO 15076-1:2005 taking 12 bytes for one XYZ triple.

aID_PRECISION and ID_GBD_SPACE specify according to Table 3 the number N of bits that are used per colour channel in order to define the coordinates of a colour in a colour space.

Table 3 – Bit depth for encoding of a colour space coordinate

ID_GBD_SPACE	ID_PRECISION	Bit depth N
0b000 or 0b001 or 0b010	0b00	8 bits
	0b01	10 bits
	0b10	12 bits
	0b11	Reserved
0b011	Any	32 bits
0b100 or 0b101 or 0b110 or 0b111	Any	Reserved

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ID_G indicates the offset in bytes from the beginning of Gamut ID metadata to the beginning of the description of gamut geometry.

If ID_E is different from 0h0000, the Gamut ID metadata contains a description of colour reproduction and ID_E indicates the offset in bytes from the beginning of Gamut ID metadata to the beginning of the description of colour reproduction. If ID_E has the value 0h0000, the Gamut ID metadata does not contain a description of colour reproduction.

7 Description of gamut geometry (full profile)

7.1 General

In the header of Gamut ID metadata, if ID_PROFILE equals 0b00, the description of gamut geometry shall correspond to the full profile.

7.2 Gamut geometry

The description of gamut geometry of the Gamut ID metadata describes the boundary of the actual colour gamut. The description of gamut geometry starts at byte number ID_G.

The description of gamut geometry contains five sets of different elements:

- gamut instances,
- gamut hulls,
- gamut components,
- faces, and
- vertices.

The logical structure of the Gamut ID description of colour gamut is shown in Figure 1.

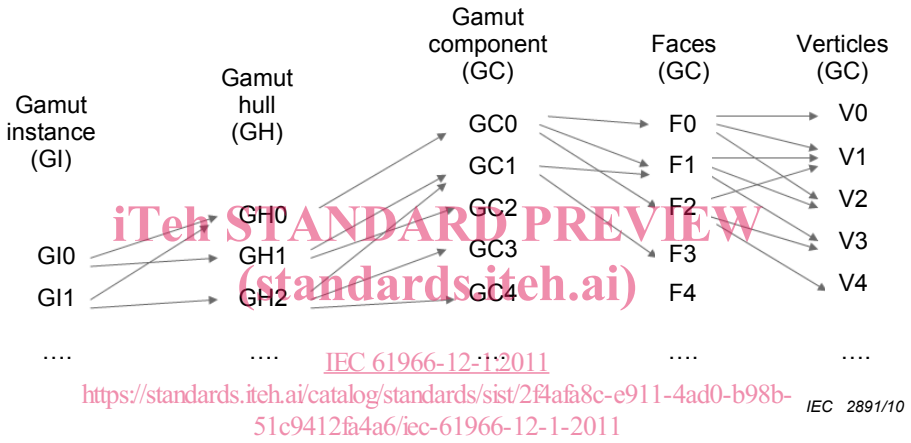

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Figure 1 – Logical structure of the description of gamut geometry (full profile)

The description of gamut geometry contains one or more gamut boundary descriptions that each describes the boundary of the same actual colour gamut. A GBD contains vertices and triangular faces. Each face is defined by the indices of three vertices.

A gamut component is a group of connex triangular faces. A GC is a part of a boundary description. A GC is defined by one ore more indices of faces.

A gamut hull is a group of connex gamut components building all together a closed surface. This surface is the boundary description of a connex volume in CIEXYZ colour space. Each GH is defined by one or more indices of GCs. A GH may refer to a single GC. In this case the GC must be a closed surface boundary description by itself. A GH may refer to a list of GCs, in that case all GCs together build a closed surface boundary description of a connex volume.

A gamut instance is a group of gamut hulls building all together a valid GBD of the actual colour gamut. A GI is defined by one or more indices of gamut hulls. A GI may refer to a single GH, in this case the single GH describes by itself the actual colour gamut. A GI may refer to a list of GHs, in this case the union of the volumes of the GHs describes the actual colour gamut.

The description of gamut geometry contains one or more different gamut instances. Each GI is a complete and valid GBD. Two GIs differ in at least one of the following characteristics:

- Level of detail
  → The higher the level, the higher the number of faces.
- Non-convex shape
  → A GI may allow or not allow the use of non-convex shapes.
- Percentage of gamut colours
  → GIs may contain different percentages of the colours of the actual colour gamut.

A GI may have additional, optional characteristics:

- Inverted gamut components
  → A GC is used as inverted GC if it referenced by one ore more GH assuming that its surface orientation is inverted.
- Indication of gamut ridges
  → Vertices may be marked as gamut ridges if they correspond to positions on the surface of the actual colour gamut having non continuous surface curvature.

The description of gamut geometry is summarized in Table 4.

Table 4 – Description of gamut geometry

Byte # hex	Description
ID_G	Header of description of gamut geometry
ID_GI	Gamut instances
ID_GH	Gamut hulls
ID_GC	Gamut components
ID_F	Faces
ID_V	Vertices

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7.3 Header of description of gamut geometry

The header of the description of gamut geometry follows the header of Gamut ID metadata and is defined according to Table 5.

Table 5 – Header of description of gamut geometry

Byte # hex	Size bytes	Symbol	Description	Values decimal
ID_G	2	ID_GI	Byte # of start of gamut instances	[0;0hFFFF]
ID_G + 02	2	ID_GH	Byte # of start of gamut hulls	[0;0hFFFF]
ID_G + 04	2	ID_GC	Byte # of start of gamut components	[0;0hFFFF]
ID_G + 06	2	ID_F	Byte # of start of faces	[0;0hFFFF]
ID_G + 08	2	ID_V	Byte # of start of vertices	[0;0hFFFF]
ID_G + 0A	1		Reserved	0
ID_G + 0B	1		Reserved	0
ID_G + 0C	1	K	Number of levels of detail	$1 \le K \le 255$
ID_G + 0D	2	F_{MAX}	Maximum number of faces in lowest level of detail	$1 < F_{MAX} \le F$ (F see Table 6)
ID_G + 0F	1	P	Number of levels of colour population	$0 < P \le 128/K$
ID_G + 10	1	$2Q_0$	Double of percentages of gamut colours	[0;200]
ID_G + 11	1	$2Q_1$	Double of percentages of gamut colours	[0;200]
:				
ID_G + 10 + P-1	1	$2Q_{P-1}$	Double of percentages of gamut colours	[0;200]
ID_G + 10 + P	1	X	Convex or non-convex shape *X=1:* all GIs and all GHs shall be convex *X=2:* GIs and GHs may be convex or non-convex	$1 \le X \le 2$

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16 bit integer or address values are encoded into 2 bytes bytes using big endian, i.e. with the MSBs in the first byte and the LSBs in the second byte.

ID_GI, ID_GH, ID_GC, ID_F and ID_V shall give the offset in bytes from the beginning of Gamut ID metadata to the beginning of gamut instances, gamut hulls, gamut components, faces and vertices data, respectively.

K indicates the number of levels of details. The Gamut ID metadata contains at least K GIs. If K = 1 there are no different level of details. Each GI is marked individually with a level of detail (0,1,…,K − 1), see Table 7.

F_{MAX} shall indicate the maximum number of faces for a GI having the lowest level of detail (level 0). See Table 7 for definition of level of details. See Table 13 for faces definition.

P indicates the number of alternative GIs populated by different percentages of colours of the actual colour gamut. If P > 1, there are P alternative GIs describing the same actual colour gamut but containing different percentages of colours of the actual colour gamut. The Gamut ID metadata contains at least P GIs. Each GI is marked individually with a population level (0,1,…, P − 1), see Table 7.