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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)

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

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FOREWORD

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International Standard IEC 61966-12-1 has been prepared by technical area 2: Colour measurement and management, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) ITU-R BT.2020 colour spaces added in Clause 6;
b) ITU-R BT.2100 colour spaces added in Clause 6.

The text of this International Standard is based on the following documents:

CDV	Report on voting
100/3126/CDV	100/3375/RVC

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

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

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

New technologies in capturing and displaying wide-gamut colour images enable a new market of wide-gamut video colour content and high dynamic range video content creation. Recent video standards for wide gamut colour space encoding such as ITU-R BT.2020 (UHDTV) and 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). Recent video standards for high dynamic range (HDR) colour space encoding, such as ITU-R BT.2100, were established in order to be able to distribute content with a colour gamut and a dynamic range that are both extended with respect to classical colour encoding, such as that defined by ITU-R BT.709. 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, this document 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 document permits video systems to define their own colour gamut. This document defines necessary metadata that allows managing inhomogeneous video systems with different colour gamuts. This document generalizes existing colour space encoding standards having a fixed colour gamut.

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.

The colour gamut metadata can 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.

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

IEC 60050-845, *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 15076-1:2010, *Image technology colour management – Architecture, profile format and data structure – Part 1: Based on ICC.1:2010*

ITU-R BT.709, *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*

ITU-R BT.2020, *Parameter values for ultra-high definition television systems for production and international programme exchange*

ITU-R BT.2100, *Image parameter values for high dynamic range television for use in production and international programme exchange*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
content
video content in production, post-production or consumption

3.1.2
gamut
solid in a colour space

Note 1 to entry: A solid in a colour space, such as specified by ITU-R BT.2100, can contain colours with high luminance.

3.1.3
gamut boundary description
description of the boundary of a colour gamut

3.1.4
radiometrically-linear colour space coordinates
colour space coordinates that are linear with respect to image radiance

3.2 Abbreviated terms

GBD gamut boundary description
LSB least significant bit
MSB most significant bit
GI gamut instance
GH gamut hull
GC gamut component

4 Overview

This document 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 5 specifies the header of Gamut ID metadata.

Clauses 6 and 7 specify the description of gamut geometry that corresponds to one of three profiles as listed below:

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

Clause 6 specifies the full profile of the description of gamut geometry. The medium and simple profiles are specified in Clause 7.

Clause 8 specifies the description of colour reproduction.

Annex A discusses the size of Gamut ID metadata.

Annex B gives background information.

Annex C discusses the use of simple, medium and full profiles.

5 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	Symbols	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_PROFILE (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: ITU-R BT.2020 R'G'B' 0b101: ITU-R BT.2020 $Y'C'_BC'_R$ 0b110: ITU-R BT.2020 $Y_C'C'_{BC}C'_{RC}$ 0b111: ID_GBD_SPACE_EXT
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	1		ID_GBD_SPACE_EXT								0h00: ITU-R BT.2100 R'G'B' PQ narrow 0h01: ITU-R BT.2100 R'G'B' PQ full 0h02: ITU-R BT.2100 R'G'B' HLG narrow 0h03: ITU-R BT.2100 R'G'B' HLG full 0h04: ITU-R BT.2100 $Y'C'_BC'_R$ PQ narrow 0h05: ITU-R BT.2100 $Y'C'_BC'_R$ PQ full 0h06: ITU-R BT.2100 $Y'C'_BC'_R$ HLG narrow 0h07: ITU-R BT.2100 $Y'C'_BC'_R$ HLG full 0h08: ITU-R BT.2100 IC_TC_P PQ narrow 0h09: ITU-R BT.2100 IC_TC_P PQ full 0h0A: ITU-R BT.2100 IC_TC_P HLG narrow 0h0B: ITU-R BT.2100 IC_TC_P HLG full 0h0C – 0hFF: reserved
06	3		Reserved. Shall be zero.								0h000000

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 in accordance with SMPTE 274M,
- 0b001: xvYCC-601, YCbCr space, encoding in accordance with IEC 61966-2-4 – SD,
- 0b010: xvYCC-709, YCbCr space, encoding in accordance with IEC 61966-2-4 – HD,
- 0b011: XYZ; encoding shall use the XYZNumber format of ICC profiles specified in ISO 15076-1:2010 taking 12 bytes for one XYZ triple.
- 0b100: ITU-R BT.2020, RGB space, encoding in accordance with ITU-R BT.2020 R', G', B',
- 0b101: ITU-R BT.2020, YCbCr space', encoding in accordance with ITU-R BT.2020 Y', C'_B, C'_R,
- 0b110: ITU-R BT.2020, YCbCr space, encoding in accordance with ITU-R BT.2020 Y_C', C'_{BC}, C'_{RC},
- 0b111: colour space and colour space encoding are indicated by ID_GBD_SPACE_EXT.

If ID_GBD_SPACE equals 0b111, ID_GBD_SPACE_EXT indicates the colour space and the colour space encoding for colour vertices in the description of gamut geometry and shall be one of:

- 0h00: ITU-R BT.2100 R'G'B', PQ format, narrow range,
- 0h01: ITU-R BT.2100 R'G'B', PQ format, full range,
- 0h02: ITU-R BT.2100 R'G'B', HLG format, narrow range,
- 0h03: ITU-R BT.2100 R'G'B', HLG format, full range,
- 0h04: ITU-R BT.2100 Y'$C'_B C'_R$, PQ format, narrow range,
- 0h05: ITU-R BT.2100 Y'$C'_B C'_R$, PQ format, full range,
- 0h06: ITU-R BT.2100 Y'$C'_B C'_R$, HLG format, narrow range,
- 0h07: ITU-R BT.2100 Y'$C'_B C'_R$, HLG format, full range,
- 0h08: ITU-R BT.2100 IC_TC_P, PQ format, narrow range,
- 0h09: ITU-R BT.2100 IC_TC_P, PQ format, full range,
- 0h0A: ITU-R BT.2100 IC_TC_P, HLG format, narrow range,
- 0h0B: ITU-R BT.2100 IC_TC_P, HLG format, full range.

ID_PRECISION, ID_GBD_SPACE and ID_GBD_SPACE_EXT specify, in accordance with 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
0b011	Any	32 bits
else	0b00	8 bits
	0b01	10 bits
	0b10	12 bits
	0b11	Reserved

If ID_GBD_SPACE equals 0b011 for XYZ encoding, bit depth N shall be 32 independent of ID_PRECISION.

BT.2020 and BT.2100 encodings are defined by the ITU-R for bit depths of 10 or 12, only.

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.

6 Description of gamut geometry (full profile)

6.1 General

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

6.2 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.

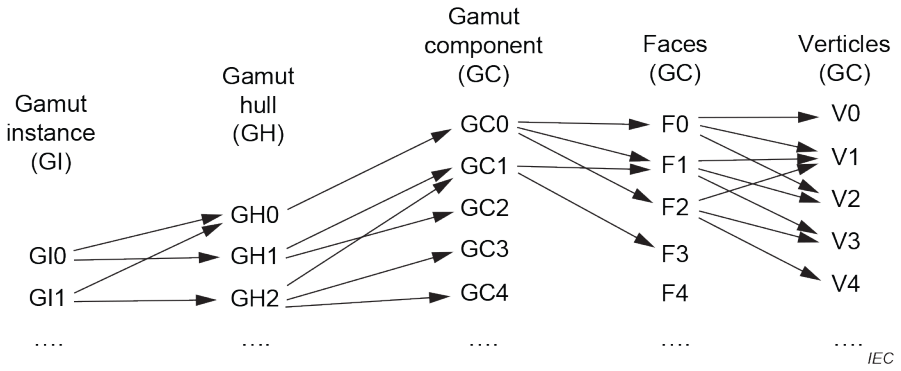

Figure 1 – Logical structure of the description of gamut geometry (full profile)

The description of gamut geometry contains one or more gamut boundary descriptions (GBD) 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 or more indices of faces.

A gamut hull (GH) 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 shall 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 (GI) 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 or 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.