# SMPTE STANDARD

# Colorimetry of P3 Color Spaces



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## Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 10E.

## Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

## Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The P3 RGB color spaces were developed around use cases involving xenon lamps and micromirror devices in digital cinema projection and are used as working color spaces in some production workflows.

RGB color spaces are in part described by the color primary chromaticities, and the white point chromaticity. These quantities form the colorimetry of an RGB color space. Color space encodings further define the transfer function, quantization, and mapping to physical quantities such as luminance and the maximum and minimum code values. This document does not define color space encodings.

This document provides a set of metadata items to use when a single identifier is needed to represent the colorimetry of a P3 RGB color space.

## 1 Scope

This standard defines the colorimetry (color primaries and white points) of P3 RGB color spaces. It also specifies metadata items including SMPTE Universal Labels which identify each RGB colorimetry. These metadata items are for use in files or encodings. It does not define a color space encoding.

## 2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; then formal languages; then figures; and then any other language forms.

## 3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ISO 11664-3:2012 (CIE S014-3/E:2011), Colorimetry – Part 3: CIE tristimulus values

SMPTE ST 400:2012, SMPTE Labels Structure

## 4 Terms and Definitions

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

### 4.1 white point

color resulting when the three signals in an RGB color system are equal

### 4.2 chromaticity coordinates

chromaticity coordinates ( $x$, $y$ ) as defined in ISO 11664-3:2012

## 5 Colorimetry

### 5.1 P3 color primaries

The P3 color primaries shall be as specified in Table 1.

**Table 1. P3 Color Primary Chromaticity Coordinates**

| | $x$ | $y$ |
|---|---|---|
| Red (R) | 0.6800 | 0.3200 |
| Green (G) | 0.2650 | 0.6900 |
| Blue (B) | 0.1500 | 0.0600 |

Note: color primary chromaticity coordinates are the same as in SMPTE RP 431-2.

# 6 Color Space Metadata Items

## 6.1 General

A color space shall comprise red, green, and blue primary chromaticities and a white point chromaticity. The naming convention for color spaces shall be "P3" followed by a white point name with no spaces or field separators.

Commonly-used color spaces using P3 colorimetry are specified in the following sections.

## 6.2 P3D65

The color space named P3D65 shall have

- color primary chromaticity coordinates specified in Table 1, and
- white point chromaticity coordinates equal to ( 0.3127, 0.3290 ).

Note: The D65 white point chromaticity coordinates are reference white in SMPTE RP 177.

## 6.3 P3D60

The color space named P3D60 shall have

- color primary chromaticity coordinates specified in Table 1, and
- white point chromaticity coordinates equal to ( 0.32168, 0.33767 ).

Note: The D60 white point is as specified in ST 2065-1 where it includes 5 significant digits.

## 6.4 P3DCI

The color space named P3DCI shall have

- color primary chromaticity coordinates specified in Table 1, and
- white point chromaticity coordinates equal to ( 0.3140, 0.3510 ).

Note: The white point chromaticity coordinates historically called ‘DCI white’ are the white reference in SMPTE RP 431-2.

# 7 Universal Label (UL) for P3 Color Spaces

## 7.1 General

The Label structure shall be as specified in SMPTE ST 400:2012.

## 7.2 Label for P3D65

The label for P3D65 shall be as defined in Table 2.

**Table 2. Label for P3D65 Color Space**

| | |
|---|---|
| Name | P3D65 Color Primaries |
| Symbol | ColorPrimaries_P3D65 |
| Item UL | urn:smpte:ul:060e2b34.0401010d.04010101.03060000 |
| Definition | Identifies P3D65 color primaries and white point |

## 7.3 Label for P3D60

The label for P3D60 shall be as defined in Table 3.

**Table 3. Label for P3D60 Color Space**

| | |
|---|---|
| Name | P3D60 Color Primaries |
| Symbol | ColorPrimaries_P3D60 |
| Item UL | urn:smpte:ul:060e2b34.0401010d.04010101.03090000 |
| Definition | Identifies P3D60 color primaries and white point |

## 7.4 Label for P3DCI

The label for P3DCI shall be as defined in Table 4.

**Table 4. Label for P3DCI Color Space**

| | |
|---|---|
| Name | P3DCI Color Primaries |
| Symbol | ColorPrimaries_P3DCI |
| Item UL | urn:smpte:ul:060e2b34.0401010d.04010101.030a0000 |
| Definition | Identifies P3DCI color primaries and white point |

# 8 Bibliography (informative)

SMPTE RP 177:1993, Derivation of basic color equations

SMPTE RP 431-2:2011, D-Cinema quality – reference projector and environment

SMPTE ST 2065-1:2012, Academy Color Encoding Specification (ACES)