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SMPTE RECOMMENDED PRACTICE

Derivation of Basic Television Color Equations



Page 1 of 4 pages

1 Scope

This practice is intended to define the numerical procedures for deriving basic color equations for color television and other systems using additive display devices. These equations are first, the normalized reference primary matrix which defines the relationship between RGB signals and CIE tristimulus values XYZ; then, the system luminance equation; and finally, the color primary transformation matrix for transforming signals from one set of reference primaries to another set of reference primaries or to a set of display primaries.

Other displays may utilize other white points. The CIE coordinates of some other standard CIE illuminants are:

	x	y
D ₅₅	0.3324	0.3474
D ₅₀	0.3457	0.3585
III C	0.3101	0.3162

(A more complete discussion of reference white and operating white is given in annex A.)

2 Normative reference

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

CIE Publication 15.2 (1986), Colorimetry

3.1.2 The chromaticity coordinates of the system reference primaries or display primaries shall be specified to a minimum of three significant digits using the 1931 CIE system of colorimetry (x, y coordinates). More precision may be used in the starting data if available. If the primary chromaticities are provided in the CIE 1976 uniform chromaticity coordinate systems (u',v'), then they must be transformed to the 1931 CIE x, y chromaticity coordinates using the transformation given below (see annex D (1)).

$$x = \frac{9u'}{12 + 6u' - 16v'}$$

$$y = \frac{4v'}{12 + 6u' - 16v'}$$

3 Reference primary matrix

3.1 Input data

3.1.1 For television systems, reference white for both reference camera and display is CIE illuminant D₆₅. The chromaticities of D₆₅, rounded to four significant digits (CIE 15.2), are:

$$\begin{aligned} x &= 0.3127 \\ y &= 0.3290 \end{aligned}$$

Should the primary chromaticities be provided in the obsolete 1960 UCS system (u,v), these values should first be transformed to the 1976 system and then to the 1931 x,y values.

$$u' = u; \quad v' = 1.5 v.$$

3.1.3 In the event that starting data are not available as chromaticity coordinates for a white