Specification of sYCC.

(Specified in Amendment 1 to IEC 61966-2-1)

Note: The definition in IEC 61966-2-1 specifies the relationship between the non-linear sRGB values (defined above as R, G and B) and sYCC. This also provides the relationship between XYZ and sYCC as shown below. By definition the chromaticity co-ordinates of the primaries; 'Gamma' and the reference white are as for sRGB.

Conversion from XYZ (D65) to sYCC:

$$\begin{bmatrix} Rs \\ Gs \\ Bs \end{bmatrix} = \begin{bmatrix} 3.2406 & -1.5372 & -0.4986 \\ -0.9689 & 1.8758 & 0.0415 \\ 0.0557 & -0.2040 & 1.0570 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

where XYZ are normalised such that Y=1 for the reference white.

The colour component transfer function is as follows:

If Rs, Gs, or Bs are less than or equal to -0.0031308

$R = -1.055*(-Rs)^{1/2.4} +0.055$
$G = -1.055*(-Gs)^{1/2.4} +0.055$
$B = -1.055*(-Bs)^{1/2.4} +0.055$

If Rs, Gs, or Bs are greater than -0.0031308 and less than or equal to 0.0031308

$R = Rs*12.92$
$G = Gs*12.92$
$B = Bs*12.92$

If Rs, Gs, or Bs are greater than 0.0031308

$R = 1.055*(Rs)^{1/2.4}-0.055$
$G = 1.055*(Gs)^{1/2.4}-0.055$
$B = 1.055*(Bs)^{1/2.4}-0.055$

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0.2990 & 0.5870 & 0.1140 \\ -0.1687 & -0.3312 & 0.5000 \\ 0.5000 & -0.4187 & -0.0813 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Note: To generate digital values from the above normalized values, it is necessary to multiply the normalized values by 2^n -1, add an offset of 2^(n-1) to Cb and Cr, and round, where n is the desired bit-depth of the digital values.

Hints for Profile makers:

1) D50 referenced characterisation data

When chromatically adapted to the D50 white point, using the recommended 'Bradford' chromatic adaptation matrix published on the ICC web site, and normalised such that Y=1 for white, the tristimulus values of the primaries and white are:

R: X=0.4360, Y=0.2225, Z=0.0139;
G: X=0.3851, Y=0.7169, Z=0.09710;
B: X=0.1431, Y=0.0606, Z=0.7139
White: X=0.9642, Y=1.00, Z=0.8249

For D50 data it is necessary to first apply a chromatic adaptation matrix. Since this is a 3x3 matrix it can be combined with the 3x3 matrix above to produce a single matrix to convert XYZ to linear sRGB (i.e. prior to applying the non-linear function). The resultant matrix (obtained by the matrix multiplication of the inverse of the chad tag given on the web site and the matrix above - with slight modifications to produce 1,1,1 for the D50 white defined in the specification) is:

$$\begin{bmatrix} Rs \\ Gs \\ Bs \end{bmatrix} = \begin{bmatrix} 3.1339 & -1.6170 & -0.4906 \\ -0.9785 & 1.9160 & 0.0333 \\ 0.0720 & -0.229 & 1.4057 \end{bmatrix} \begin{bmatrix} X_{(50)} \\ Y_{(50)} \\ Z_{(50)} \end{bmatrix}$$

2) Measurement 'correction'

The above transformation produces 1 and 0 in each of RGB when XYZ is set to 0.9642, 1, 0.8249 and 0, 0, 0 respectively. However, in practice some degree of flare will be present if the sRGB from which the sYCC is calculated is intended to represent a real viewing situation. The amount of this flare will vary with the actual conditions used. However, it has been concluded by the committee developing ISO 22028-1 (a standard pertaining to colour image encodings) that for measurement consistency a level of flare should be assumed for display RGB colour encodings that is consistent with the 0/45 measurement condition assumed for ICC PCS measurements. The specification in IEC 61966-2-1 states that the white should be assumed to have a luminance of 80cd/m^2 and defines other viewing conditions that has led to the conclusion in ISO 22028-1 that a reference black would have a luminance of 1 cd/m^2. This would be the luminance measured at the position of the observer. So, it is recommended that profile makers utilise this information when producing profiles and assume the black point has a Y value of 0.0125 when the white is 1. This correction can be achieved by applying the following corrections to the computed RGB values (prior to conversion to sYCC):

sRGB′ = 0.0125 - 0.868423*(0.055 - sRGB)^2.4	sRGB < = -0.04045
sRGB′ = 0.0125 + 0.0764319 * sRGB	sRGB >= -0.04045 and <= 0.04045
sRGB′ = 0.0125 + 0.868423*(0.055 + sRGB)^2.4	sRGB > 0.04045