CIELAB 1976 $L^*a^*b^*$−color space definition and reversal

$$L^* = 116\,(Y/Y_n)^{1/3} - 16$$
$$a^* = 500\,[\,(X/X_n)^{1/3} - (Y/Y_n)^{1/3}\,]$$
$$b^* = 200\,[\,(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}\,]$$

$$X = X_n\,[\,(L^* + 16)/116 + a^*/500\,]^3$$
$$Y = Y_n\,[\,(L^* + 16)/116\,]^3$$
$$Z = Z_n\,[\,(L^* + 16)/116 - b^*/200\,]^3$$

AES10−1N

Q-function changes; transition from light- to color metrics

scaling function of **light metrics:**
$\boldsymbol{Q\,[k(x - u]} = Q[k(\log L - \log L_u)]$
$\log L \to \log P$ **for color metrics:**
$Q[k(\log P - \log L_u)]$
$= Q[k(\log L - \log L_u + \log P - \log L)]$
with saturation $p = \log P - \log L$
for color metrics: $\boldsymbol{Q\,[k(x - u + p)]}$

AES10−2N

Color space CIELAB 1976, color values, -attributes, -chromaticities *(a', b')*

tristimulus values *X, Y, Z* −> color attributes *L*, a*, b**

lightness $L^* = 116\,(Y/Y_n)^{1/3} - 16$

RG−chromaticness $a^* = 500\,[\,(X/X_n)^{1/3} - (Y/Y_n)^{1/3}\,] = 500\,[\,a' - a'_n\,]\,Y^{1/3}$

JB−chromaticness $b^* = 200\,[\,(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}\,] = 500\,[\,b' - b'_n\,]\,Y^{1/3}$

color attributes *L*, a*, b −> tristimulus values *X, Y, Z***

tristimulus values
$$X = X_n\,[\,(L^* + 16)/116 + a^*/500\,]^3$$
$$Y = Y_n\,[\,(L^* + 16)/116\,]^3$$
$$Z = Z_n\,[\,(L^* + 16)/116 - b^*/200\,]^3$$

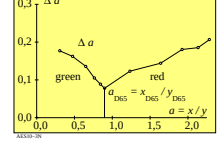
chromaticity for CIELAB 1976, LABHNU 1977, LABHNU1 1979

CIELAB 1976, 2^0	$a' = 0{,}2191\,(x/y)^{1/3}$	$b' = -\,0{,}08376\,(z/y)^{1/3}$
LABHNU 1977	$a' = (x/y + 1/6)^{1/3}\,/\,4$	$b' = -\,(z/y + 1/6)^{1/3}\,/\,12$
LABHNU1 1979	$a' = (x/y + 1)\,/\,15$ *linear!*	$b' = -\,(z/y + 1/6)^{1/3}\,/\,12$
LABHNU2 1979	$a' = (x/y + 1/6)^{2/3}\,/\,15$	$b' = -\,(z/y + 1/6)^{1/3}\,/\,12$
CIELAB 1976, 10^0	$a' = 0{,}2193\,(x_{10}/y_{10})^{1/3}$	$b' = -\,0{,}08417\,(z_{10}/y_{10})^{1/3}$

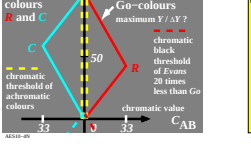
chromaticity constants
CIELAB, 2^0,10^0: $a_2 = 500\,(1/X_n)^{1/3} = 0{,}2191$; $a_{10} = 500\,(1/X_{n10})^{1/3} = 0{,}2193$; $b_2 = -\,200\,(1/Z_n)^{1/3} = -\,0{,}08376$; $b_{10} = -\,200\,(1/Z_{n10})^{1/3} = -\,0{,}08417$

AES11−3N

chromaticity diff. for *RG*−thresholds



AES10−2R



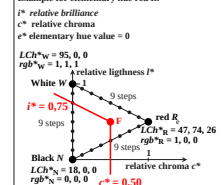
AES10−4N

User friendly colorimetric CIE colour notation *ice** and linear relations between *rgb** and CIELAB data

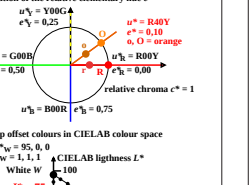
Example for elementary hue red *R*:

i relative brilliance*
*c** relative chroma
*e** elementary hue value = 0

*LCh*w* = 95, 0, 0
*rgb*w* = 1, 1, 1

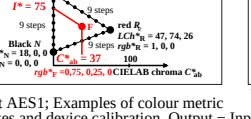


Notation of the relative elementary hue *e**



9 step offset colours in CIELAB colour space

*LCh*w* = 95, 0, 0
*rgb*w* = 1, 1, 1



examples for user colour notation:

*ice** = 0,75 0,50 0,00 *or*
*rgb** = 0,75 0,25 0,00
*L**=47; C^*_{ab}=75; h_{ab}=26
*L**=18; *L*w*=95

AES10−7N

Output − Input − Output: A loop for relative colour fidelity with the visual *rgb** and *LCh** CIELAB data

Produce a reference test chart with 729 CIELAB colours or buy one, or use PG4311L of *Colour and Colour Vision*, see http://standards.iso.org/iso/9241/306/ed-2/ES15.PDF

Example: Linearized output in offset print
Output linearization produces for 729=9·9·9 *rgb* input data the 729 *LCh** CIELAB output colours. Use the file http://standards.iso.org/iso/9241/306/ed-2/AE49/AE49F0PX_CY8_1.PDF

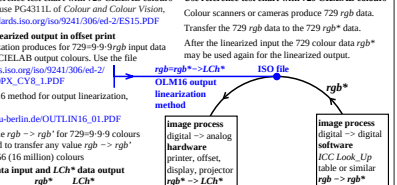
Use the OLM16 method for output linearization, see http://farbe.li.tu-berlin.de/OUTLIN16_01.PDF

produce a Table *rgb* −> *rgb'* for 729=9·9·9 colours apply a method to transfer any value *rgb* −> *rgb'* for 256·256·256 (16 million) colours

Offset *rgb data input and *LCh** data output**

Color	*rgb**	*LCh**
R elementary red	1 0 0	47, 74, **26**
Y elementary yellow	1 1 0	86, 88, **92**
G elementary green	0 1 0	53, 57, **164**
B elementary blue	0 0 1	42, 45, **271**
N black	0 0 0	18, **0, 0**
W white	1 1 1	95, **0, 0**

(data according to test chart DIN 33872-2, p. 9-12)



Use reference test chart with 729 CIELAB colours
Colour scanners or cameras produce 729 *rgb* data.
Transfer the 729 *rgb* data to the 729 *rgb** data.
After the linearized input the 729 colour data *rgb** may be used again for the linearized output.

AES11−7N

see similar files: http://farbe.li.tu-berlin.de/AES1/AES1.HTM
technical information: http://farbe.li.tu-berlin.de or http://130.149.60.45/~farbmetrik

TUB registration: 20201101-AES1/AES1L0N1.TXT /.PS
application for evaluation and measurement of display or print output

TUB material: code=rha4ta