

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

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

$$a^* = 500 [(X/X_n)^{1/3} - (Y/Y_n)^{1/3}]$$

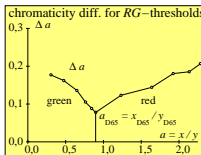
$$b^* = 200 [(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}]$$

$$X = X_n [(L^* + 16) / 116 + a^*/500]^3$$

$$Y = Y_n [(L^* + 16) / 116]^3$$

$$Z = Z_n [(L^* + 16) / 116 - b^*/200]^3$$

UE200-1N

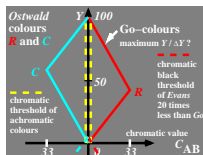


UE200-3N

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

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

UE200-2N



UE200-4N

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

tristimulus values $X, Y, Z \rightarrow$ color attributes L^*, a^*, b^*

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

RG -chromaticness $a^* = 500 [(X/X_n)^{1/3} - (Y/Y_n)^{1/3}] = 500 [a^* - a_n^*]^{1/3}$

JB -chromaticness $b^* = 200 [(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}] = 500 [b^* - b_n^*]^{1/3}$

color attributes $L^*, a^*, b^* \rightarrow$ 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° $a^* = 0,2191 (x/y)^{1/3}$ $b^* = -0,08376 (z/y)^{1/3}$

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° $a^* = 0,2193 (x_{10}/y_{10})^{1/3}$ $b^* = -0,08417 (z_{10}/y_{10})^{1/3}$

chromaticity constants $a_2 = 500 (1/X_2)^{1/3} = 0,2191$ $b_2 = -200 (1/Z_2)^{1/3} = -0,08376$

CIELAB, 2°, 10° $a_{10} = 500 (1/X_{a10})^{1/3} = 0,2193$ $b_{10} = -200 (1/Z_{a10})^{1/3} = -0,08417$

UE201-3N

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

Example for elementary hue red R :

i^* relative brilliance

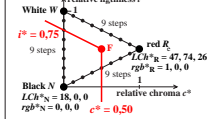
c^* relative chroma

c^* relative hue value = 0

$LCh^*w = 95, 0, 0$

$rgb^*w = 1, 1, 1$

relative lightness i^*



examples for user colour notation:

$ic^* = 0,75 \ 0,50 \ 0,00$ or

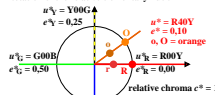
$rgb^* = 0,75 \ 0,25 \ 0,00$

$L^* = 47; C^*_{ab} = 75; h_{ab} = 26$

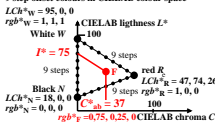
$L^*_N = 18; L^*_w = 95$

UE200-7N

Notation of the relative elementary hue c^*



9 step offset colours in CIELAB colour space



UE200-8N

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 data. Use the file http://standards.iso.org/iso/9241/306/ed-2/AE49/AE49F0P_CY8_1.PDF

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

produce a Table $rgb \rightarrow rgb^*$ for 729-9-9-9 colours apply a method to transfer any value $rgb \rightarrow rgb^*$ 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

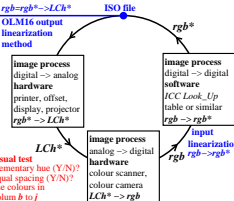
(data according to test chart DIN 33872-2, p. 9-12)

UE201-7N

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.



input: $w/rgb/cmyk \rightarrow w/rgb/cmyk$
output: no change