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

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

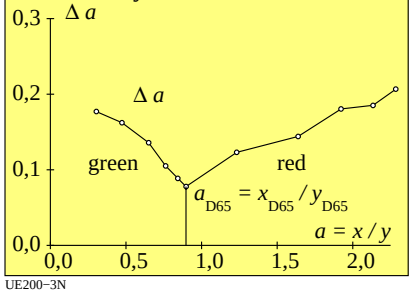
scaling function of **light metrics:**
$Q\,[k(x - u)] = Q[k(\log L - \log L_u)]$

$\log L \rightarrow \log P$ **for color metrics:**
$Q[k(\log P - \log L_u)]$
$= Q[k(\log L - \log L_u + \log P - \log L)]$

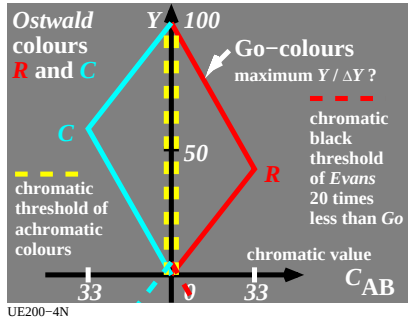
with saturation $p = \log P - \log L$
for color metrics: $Q\,[k(x - u + p)]$

UE200−2N

chromaticity diff. for RG−thresholds



UE200−3N



UE200−4N

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

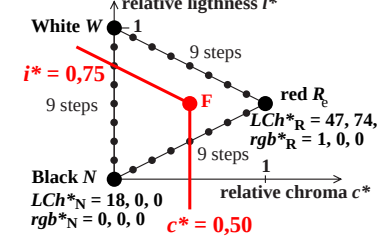
CIELAB 1976, 2^o	$a' = 0{,}2191\,(x/y)^{1/3}$	$b' = -\,0{,}08376\,(z/y)^{1/3}$
LABHNU 1977	$a' = (x/y + 1/6)^{1/3} / 4$	$b' = -\,(z/y + 1/6)^{1/3} / 12$
LABHNU1 1979	$a' = (x/y + 1) / 15$ *linear!*	$b' = -\,(z/y + 1/6)^{1/3} / 12$
LABHNU2 1979	$a' = (x/y + 1/6)^{2/3} / 15$	$b' = -\,(z/y + 1/6)^{1/3} / 12$
CIELAB 1976, 10^o	$a' = 0{,}2193\,(x_{10} / y_{10})^{1/3}$	$b' = -\,0{,}08417\,(z_{10} / y_{10})^{1/3}$
chromaticity constants CIELAB, 2^o,10^o	$a_2 = 500\,(1/X_n)^{1/3} = 0{,}2191$ $a_{10} = 500\,(1/X_{n10})^{1/3} = 0{,}2193$	$b_2 = -\,200\,(1/Z_n)^{1/3} = -\,0{,}08376$ $b_{10} = -\,200\,(1/Z_{n10})^{1/3} = -\,0{,}08417$

UE201−3N

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

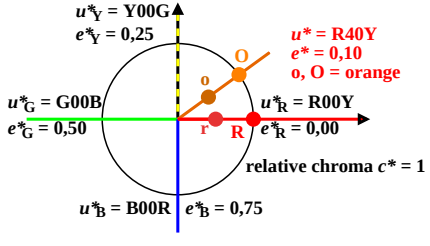
Example for elementary hue red *R:*

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

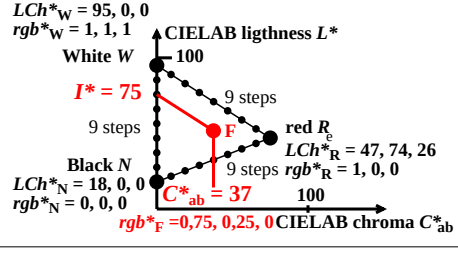


examples for user colour notation:
ice* = 0,75 0,50 0,00 **or**
rgb* = 0,75 0,25 0,00
L^*=47; C^*_{ab}=75; h_{ab}=26
L^*_N=18; L^*_W=95

Notation of the relative elementary hue *e**



9 step offset colours in CIELAB colour space



UE200−7N

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

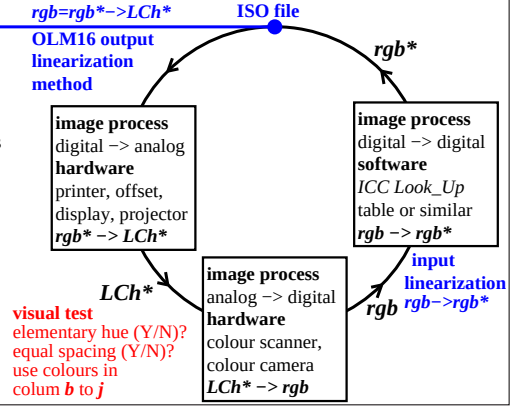
produce a Table *rgb −> rgb'* for 729=9·9·9 colours
apply a method to transfer any value *rgb −> rgb'* for 256·256·256 (16 million) colours

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

Color	*rgb**	*LCh**
R_e elementary red	**1 0 0**	47, 74, **26**
Y_e elementary yellow	**1 1 0**	86, 88, **92**
G_e elementary green	**0 1 0**	53, 57, **164**
B_e 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.



UE201−7N

input: *w/rgb/cmyk −> w/rgb/cmyk*
output: no change