CIEBased*ABC*−color space transformation *ABC* −> XYZ*
CIELAB part 1: *ABC* −> LMN**

$$A = \text{DecodeA}^* = \{16 \text{ add } 116 \text{ div}\}$$
$$B = \text{DecodeB}^* = \{500 \text{ div}\}$$
$$C = \text{DecodeC}^* = \{200 \text{ div}\}$$

$$\begin{pmatrix} L^* \\ M^* \\ N^* \end{pmatrix} = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & -1 \end{pmatrix} \times \begin{pmatrix} A \\ B \\ C \end{pmatrix}$$

NE360−1, B8_36_1

CIEBased*ABC*−color space transformation *ABC* −> XYZ*
CIELAB part 2: *LMN* −> XYZ*

$$L = \text{DecodeL}^* = \{3 \text{ exp}\}$$
$$M = \text{DecodeM}^* = \{3 \text{ exp}\}$$
$$N = \text{DecodeN}^* = \{3 \text{ exp}\}$$

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} X_n & L \\ Y_n & M \\ Z_n & N \end{pmatrix}$$

NE360−2, B8_36_2

CIELAB *L*a*b**−color space

```
[/CIEBasedABC<<   %Dict PostScript Level 2
 /MatrixABC [1 0 0 0 1 0 0 0 1]  %default
 /DecodeABC [{16 add 116 div} bind
     {500 div} bind {200 div} bind ]
 /RangeABC [0 100 −128 127 −128 127] %Lab*
 /MatrixLMN [0.9505 0 0 0 1 0 0 0 1.0890]
 /DecodeLMN [{3 exp} {3 exp} {3 exp}]
 /RangeLMN [ 0 0.9505 0 1 0 1.0890] %D65
 /WhitePoint [0.9505 1 1.0890] %D65
 /BlackPoint [0 0 0] % default
>>]setcolorspace
```

NE360−3, B8_36_3

CIEBased*ABC* -optimization of color rendering $Lab^*_{soll} - Lab^*_{eopt}$

PSL2-program output measure

L^*_{aim} L −> L^* −> L L^*_{real}
a^*_{aim} −> M −> M^* −> M −> a^*_{real}
b^*_{aim} N −> N^* −> N b^*_{real}

$L^*_{aimc} = L^*_{aim} + (L^*_{aim} - L^*_{real})$ L^*_{eopt}
$a^*_{aimc} = a^*_{aim} + (a^*_{aim} - a^*_{real})$ =>a^*_{eopt}
$b^*_{aimc} = b^*_{aim} + (b^*_{aim} - b^*_{real})$ b^*_{eopt}

NE360−4, B8_37_1

least square fit for color rendering $Lab^*_{i,aim} - Lab^*_{i,gopt}$ = Min.

color-differences $\Delta(Lab^*)$ for CIE-test colors i = 1, 2, ..., 17

$$\Delta L^*_i = L^*_{i,aim} - L^*_{i,gopt}$$
$$\Delta a^*_i = a^*_{i,aim} - a^*_{i,gopt}$$
$$\Delta b^*_i = b^*_{i,aim} - b^*_{i,gopt}$$

$$\sum [(\Delta L^*_i)^2 + (\Delta a^*_i)^2 + (\Delta b^*_i)^2]^{1/2} = \text{Min.}$$

i = 1,17

NE360−5, B8_37_2

least square fit for color rendering $Lab^*_{i,aim} - Lab^*_{i,gopt}$ = Min.

color-differences $\Delta(Lab^*_i)$ for CIE-test colors i = 1 to 17 −> min.

$$\begin{pmatrix} L^*_{i,gopt} \\ a^*_{i,gopt} \\ b^*_{i,gopt} \end{pmatrix} = \begin{pmatrix} a_{11} & a_{21} & a_{31} \\ a_{12} & a_{22} & a_{32} \\ a_{13} & a_{23} & a_{33} \end{pmatrix} \times \begin{pmatrix} L^*_{i,aim} \\ a^*_{i,aim} \\ b^*_{i,aim} \end{pmatrix}$$

$$\sum [(\Delta L^*_i)^2 + (\Delta a^*_i)^2 + (\Delta b^*_i)^2]^{1/2} = \text{Min.}$$

i = 1,17

NE360−6, B8_37_3

PSL2-program code: definition and reproduction of 17 CIE-test colors

```
%!PS-Adobe-3.0 B7221-7n.eps  20.10.94
%%BoundingBox: 72 90 226 206
/FS {findfont exch scalefont setfont} bind def
/MM {72 25.4 div mul} def
/languagelevel where {pop languagelevel} {1} ifelse
                              /PSL12 exch def
/dictende {counttomark 2 idiv dup dict begin {def}
          repeat pop currentdict end} bind def
%%EndProlog

72 90 translate  0.01  MM  dup  scale  20 setlinewidth

PSL12 2 eq {[ /CIEBasedABC [ %color space and limits for D65
 /WhitePoint  [0.9505 1 1.089]          %CIEXYZ for D65
 /RangeABC [0 0.9505  0 1  0 1.0885] %CIEXYZ-limits N/W
 /RangeLMN [0 0.9505  0 1  0 1.0885] dictende ]
  setcolorspace } if  %end standard definition PSL2-CIEBasedA

PSL12 1 eq                          %definition for PSL1-devices
 { {/setrgbcolor where              %question for PSL1-color device
     {pop setrgbcolor}                      %PSL1-color device
     {pop 0.4 exp setgray pop} ifelse }     %PSL1->NW-device
 /setcolor exch def} if

/colRec {moveto s 0 rlineto 0 s rlineto s neg 0 rlineto %square
  closepath setcolor} bind def

0.1885 0.1983 0.2157 setcolor %test color no. 16 (mean gray)

0 0 moveto 5400 0 rlineto 0 4000 rlineto   %image size 54mm x 40mm
           -5400 0 rlineto closepath fill

250 /Times-Bold FS   0.7239 0.7615 0.8289 setcolor %white
3200 3300 moveto (17 CIE-test colors) show

500 500 translate  %zero point lower left test color

/s 600 def  /xw 1000 def  /yw 800 def %square width and distances

%   X     Y     Z      x,y-position       fill color rectangle
 0.3298 0.2976 0.2459 0                  colRec fill %CIE-TF01
 0.2748 0.2890 0.1501 xw 1 mul yw 0 mul colRec fill %CIE-TF02
 0.2393 0.3043 0.0996 xw 2 mul yw 0 mul colRec fill %CIE-TF03
 0.2045 0.2948 0.2127 xw 3 mul yw 0 mul colRec fill %CIE-TF04
 0.2502 0.3087 0.4042 xw 4 mul yw 0 mul colRec fill %CIE-TF05
 0.2826 0.2983 0.5791 0          yw 1 mul colRec fill %CIE-TF06
 0.3333 0.2939 0.5322 xw 1 mul yw 1 mul colRec fill %CIE-TF07
 0.3757 0.3131 0.4544 xw 2 mul yw 1 mul colRec fill %CIE-TF08
 0.2048 0.1120 0.0436 xw 3 mul yw 1 mul colRec fill %CIE-TF09
 0.5487 0.5894 0.1208 xw 4 mul yw 1 mul colRec fill %CIE-TF10
 0.1212 0.2035 0.1533 0          yw 2 mul colRec fill %CIE-TF11
 0.0628 0.0647 0.2773 xw 1 mul yw 2 mul colRec fill %CIE-TF12
 0.5885 0.5709 0.4139 xw 2 mul yw 2 mul colRec fill %CIE-TF13
 0.0935 0.1171 0.0543 xw 3 mul yw 2 mul colRec fill %CIE-TF14
 0.0342 0.0359 0.0394 0          yw 3 mul colRec fill %CIE-TF15 N
 0.1885 0.1983 0.2157 xw 1 mul yw 3 mul colRec fill %CIE-TF16 Z
 0.7239 0.7615 0.8289 xw 2 mul yw 3 mul colRec fill %CIE-TF17 W
 0.7239 0.7615 0.8289 xw 1 mul yw 3 mul colRec stroke  %-TF17 W

1 1 17 {/nr1 exch def          %squares and text no. 1 to 17
  nr1 9 gt {/xp 300 def}{/xp 200 def} ifelse
  nr1 14 gt {/nr nr1 1 add def} {/nr nr1 def} ifelse
  nr 1 sub 5 idiv /i exch def
  nr 1 sub 5 mod /j exch def
   j xw mul xp sub 1 yw mul 20 add moveto
   nr1 4 string cvs show } for
showpage
```

NE361-7, B8_38