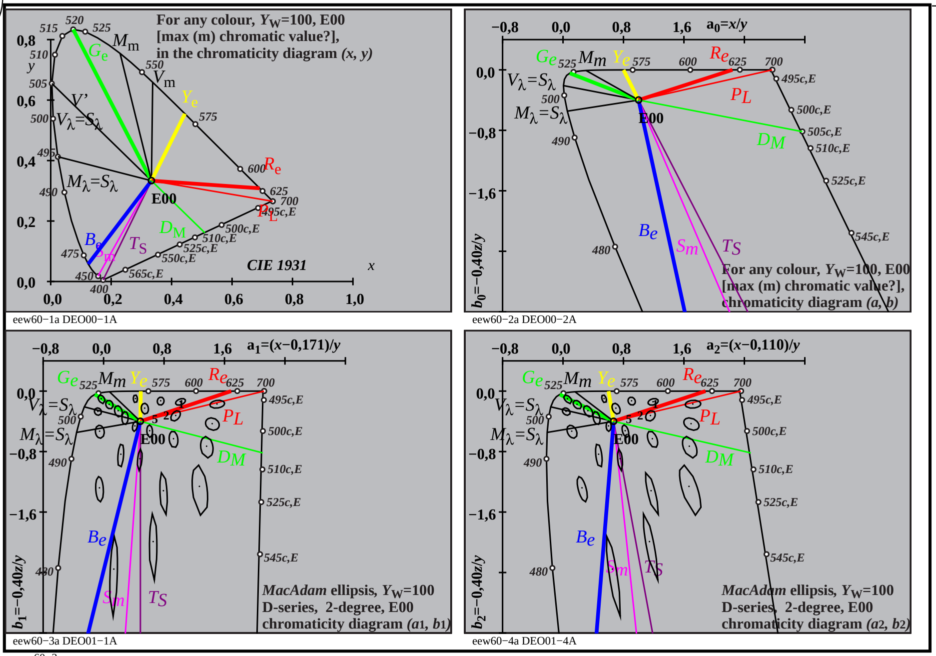

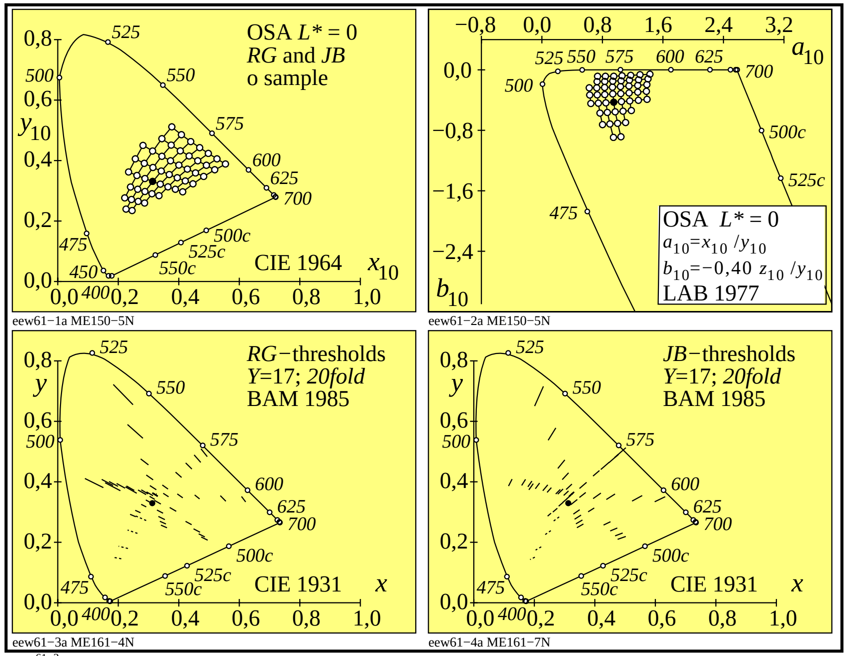

Line-element equations according to CIE 230:2019

Colour-threshold (t) function $f_t(x) = \Delta Y_t = \Delta x\, Y_u$ [0]

$\Delta Y_t=(A_1+A_2Y)/A_0$ A_0=1,5, A_1=0,0170, A_2=0,0058

$f_{tu}(x) = \frac{\Delta Y_t}{\Delta Y_{tu}} = \frac{1+b\,x}{1+b}$ $b=A_2Y_u/A_1$ $x=Y/Y_u$ [1]

$F_{tu}(x) = \int \frac{f'_{tu}(x)}{f_{tu}(x)}dx = \int \frac{b}{1+b\,x}\,dx$ [2]

Example for $L^*_{tu}(x)$, ΔY_t with $x=Y/Y_u$, $x_u=1$, b=6,141:

$L^*_{tu}(x) = \frac{L^*_t(x)}{L^*_{tu}(x)} = \frac{\ln(1+b\,x)}{\ln(1+b)}$ [3]

$f_{tu}(x) = \frac{\Delta Y_t}{\Delta Y_{tu}} = \frac{1+b\,x}{1+b}$ [4]

eew60−5a ens00−5n

Line-element equations: loudness − sound level [1]

Simple equation by the ***Weber-Fechner* law** between the loudness N^* and the sound level E

$\frac{\Delta N^*}{N^*} = n\,\frac{\Delta E}{E}$ [1]

It is assumed at the hearing threshold E_s

$\frac{\Delta N^*}{N^*+N^*_s} = n\,\frac{\Delta E}{E+E_s}$ [2]

Integration on both sides and requirement N^*=0 for E=0

$N^*= N^*_s\,[\,(1+\frac{E}{E_s})^n-1\,]$ [3]

Small change with threshold factor s and N^*=0 for $E=E_s$

$N^*= N^*_s\,[\,(1+s\frac{E-E_s}{E_s})^n-1\,]$ [4]

1) *Zwicker E., Feldkeller R.*, (1967), Das Ohr als Nachrichtenempfänger (the ear as information receiver), Hirzel-Verlag, 232 pages, see 133−139

eew60−6a ens00−6n

Line-element equations: lightness − luminance [1]

Simple equation by the ***Weber-Fechner* law** between the lightness L^* and the luminance L

$\frac{\Delta L^*}{L^*} = n\,\frac{\Delta L}{L}$ [1]

It is assumed at the luminance threshold L_s

$\frac{\Delta L^*}{L^*+L^*_s} = n\,\frac{\Delta L}{L+L_s}$ [2]

Integration on both sides and requirement L^*=0 for L=0

$L^*= L^*_s\,[\,(1+\frac{L}{L_s})^n-1\,]$ [3]

Small change with threshold factor s and L^*=0 for $L=L_s$

$L^*= L^*_s\,[\,(1+s\frac{L-L_s}{L_s})^n-1\,]$ [4]

1) *Richter, Klaus.*, (1969), Antagonistic signals in colour vision and relation with the perceived colour order (in German), Dis. Universität Basel, 150 pages, see 115-123

eew60−7a ens00−7n

Line-element equations: lightness − tristimulus value

Richter [1] has used the following equation to approximate between the lightness L^* and the tristimulus value Y

$L^*= L^*_s\,[\,(1+s\frac{Y-Y_s}{L_s})^n-1\,]$ [1]

The parameters are for the *Munsell Value* function [2]

L^*_s=2,5125 s=0,4250 Y_s=0,1551 n=0,3333 [2]

The parameters are for the *CIELAB-lightness* function [3]

$L^* = 116\,(Y/Y_n)^{1/3}-16$ (0,8<Y<100, Y_n=100) [3]

L^*_s=2,5125 s=0,4250 Y_s=0,1551 n=0,3333 [4]

1) *Richter, Klaus.*, (1969), Antagonistic signals in colour vision and relation with the perceived colour order (in German), Dis. Universität Basel, 150 pages, see 115-123, 74 MB, see for free download https://edoc/unibas.ch/72306/
2) *Newhall, S.M., Nickerson, D., Judd, D.B.* (1943), *Final report of the O.S.A. subcommittee on the spacing of Munsell Colors, OSA 33, 385-418, see p. 417*
3) ISO/CIE 11664−4:2019 Colorimetry, CIE 1976 L*a*b* colour space

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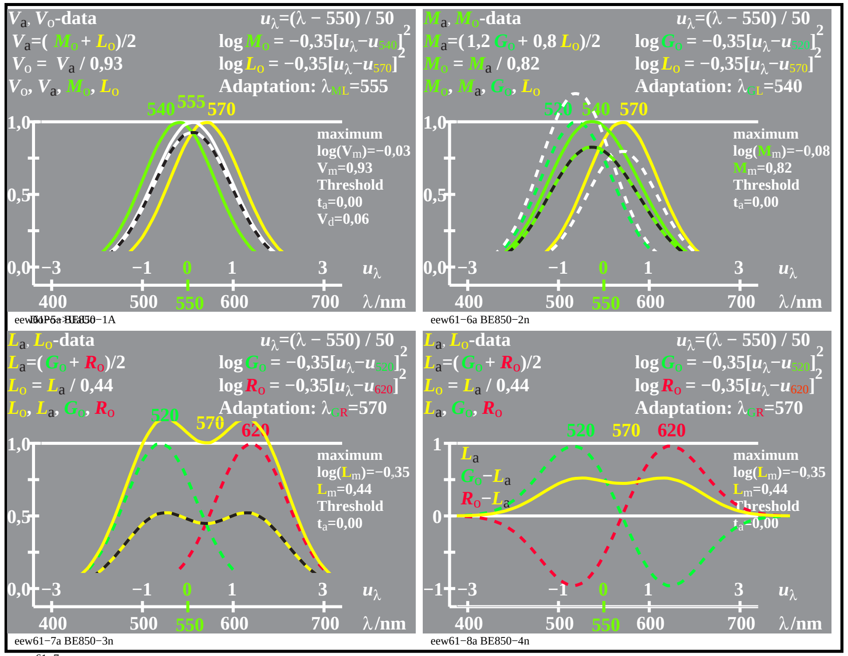

see similar files of the whole serie: http://farbe.li.tu-berlin.de/eews.htm
technical information: http://farbe.li.tu-berlin.de or http://color.li.tu-berlin.de

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