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

TUB registration: 20241001-heo3/heo3l0na.txt /.ps
application for evaluation and measurement of display or print output

TUB material: code=rha4ta

log (L^*/L^*_u) — CIELAB lightness L^* normalized to the background lightness L^*_u

L^*/L^*_u

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$L^*/L^*_u=g(Y/Y_u)^n-h$ $(g=r/(r-d)=1,32, h=d/(r-d)=0,32)$ [1c]
$\log[(L^*/L^*_u+h)/g]=n\,\log(Y/Y_u)$ [1d]
$\ln[(L^*/L^*_u+h)/g]=\ln(10)\,n\,\log(Y/Y_u)$ [1e]
$(L^*/L^*_u+h)/g=e^{\ln(10)\,n\,\log(Y/Y_u)}$ [1f]

$m_{nu}=n=0,333$
$m_u=0,438$

0,301
−0,745

heo30−1a

log $(\Delta Y/\Delta Y_u)$ — CIELAB tristimulus value difference ΔY normalized to ΔY_u

$\Delta Y/\Delta Y_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$dY=[Y_n/(n\,s)]\,(Y/Y_n)^{1-n}$ [2c]
$dY_u=[Y_n/(n\,s)]\,(Y_u/Y_n)^{1-n}=1,4602$ [2d]
$dY/dY_u=(Y/Y_u)^{1-n}$ [2e]
$\log(dY/dY_u)=(1-n)\,\log(Y/Y_u)$ [2f]

$m_{nu}=1-n=0,666$
$m_u=0,666$

0,489
−0,843

heo30−2a

L^*/L^*_u — CIELAB lightness L^* normalized to the background lightness L^*_u

L^*/L^*_u

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$L^*/L^*_u=g(Y/Y_u)^n-h$ $(g=r/(r-d)=1,32, h=d/(r-d)=0,32)$ [1c]

$m_{u90\_4}=0,840, f_{90}=95, f_4=23$
$m_u=1,170$

2,000
0,179

heo31−1a

$\Delta Y/\Delta Y_u$ — CIELAB tristimulus value difference ΔY normalized to ΔY_u

$\Delta Y/\Delta Y_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$dY=[Y_n/(n\,s)]\,(Y/Y_n)^{1-n}$ [2c]
$dY_u=[Y_n/(n\,s)]\,(Y_u/Y_n)^{1-n}=1,4602$ [2d]
$dY/dY_u=(Y/Y_u)^{1-n}$ [2e]

$m_{u90\_4}=0,024, f_{90}=2, f_4=0$
$m_u=0,029$

3,089
0,143

heo31−2a

log $[(\Delta Y/Y)/(\Delta Y/Y)_u]$ — CIELAB-Y sensitivity normalized to $(\Delta Y/Y)_u$

$S_r/S_{ru}=(\Delta Y/Y)/(\Delta Y/Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$dY/Y=[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]/Y$ [3c]
$(dY/Y)_u=[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]/Y_u$ [3d]
$(dY/Y)/(dY/Y)_u=(Y/Y_u)^{-n}$ [3e]
$\log[(dY/Y)/(dY/Y)_u]=(-n)\,\log(Y/Y_u)$ [3f]

$m_{nu}=-n=-0,333$
$m_u=-0,333$

0,421
−0,244

heo30−3a
heo30−3n

log$[(Y/\Delta Y)/(Y/\Delta Y)_u]$ — CIELAB-Y contrast normalized to $(Y/\Delta Y)_u$

$C_r/C_{ru}=(Y/\Delta Y)/(Y/\Delta Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$Y/dY=Y/\{[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]\}$ [4c]
$(Y/dY)_u=Y_u/\{[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]\}$ [4d]
$(Y/dY)/(Y/dY)_u=(Y/Y_u)^n$ [4e]
$\log[(Y/dY)/(Y/dY)_u]=(n)\,\log(Y/Y_u)$ [4f]

$m_{nu}=n=0,333$
$m_u=0,333$

0,244
−0,421

heo30−4a

$(\Delta Y/Y)/(\Delta Y/Y)_u$ — CIELAB-Y sensitivity normalized to $(\Delta Y/Y)_u$

$S_r/S_{ru}=(\Delta Y/Y)/(\Delta Y/Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$dY/Y=[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]/Y$ [3c]
$(dY/Y)_u=[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]/Y_u$ [3d]
$(dY/Y)/(dY/Y)_u=(Y/Y_u)^{-n}$ [3e]

$m_{u90\_4}=-0,000, f_{90}=0, f_4=0$
$m_u=-0,000$

2,640
0,568

heo31−3a
heo31−3n

$(Y/\Delta Y)/(Y/\Delta Y)_u$ — CIELAB-Y contrast normalized to $(Y/\Delta Y)_u$

$C_r/C_{ru}=(Y/\Delta Y)/(Y/\Delta Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=116, n=1/3, d=16)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=65,49, L^*_u=r-d)$ [1b]
$Y/dY=Y/\{[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]\}$ [4c]
$(Y/dY)_u=Y_u/\{[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]\}$ [4d]
$(Y/dY)/(Y/dY)_u=(Y/Y_u)^n$ [4e]

$m_{u90\_4}=0,280, f_{90}=37, f_4=13$
$m_u=0,390$

1,757
0,378

heo31−4a

log (L^*/L^*_u) — IECsRGB lightness L^* normalized to the background lightness L^*_u

L^*/L^*_u

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$L^*/L^*_u=(Y/Y_u)^n$ [1c]
$\log(L^*/L^*_u)=n\,\log(Y/Y_u)$ [1d]
$\ln(L^*/L^*_u)=\ln(10)\,n\,\log(Y/Y_u)$ [1e]
$L^*/L^*_u=e^{\ln(10)\,n\,\log(Y/Y_u)}$ [1f]

$m_{nu}=n=0,416$
$m_u=0,416$

0,301
−0,532

heo30−5a

log $(\Delta Y/\Delta Y_u)$ — IECsRGB tristimulus value difference ΔY normalized to ΔY_u

$\Delta Y/\Delta Y_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$dY=[Y_n/(n\,s)]\,(Y/Y_n)^{1-n}$ [2c]
$dY_u=[Y_n/(n\,s)]\,(Y_u/Y_n)^{1-n}=1,1746$ [2d]
$dY/dY_u=(Y/Y_u)^{1-n}$ [2e]
$\log(dY/dY_u)=(1-n)\,\log(Y/Y_u)$ [2f]

$m_{nu}=1-n=0,583$
$m_u=0,583$

0,421
−0,745

heo30−6a

L^*/L^*_u — IECsRGB lightness L^* normalized to the background lightness L^*_u

L^*/L^*_u

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$L^*/L^*_u=(Y/Y_u)^n$ [1c]

$m_{u90\_4}=0,808, f_{90}=95, f_4=26$
$m_u=1,098$

2,000
0,293

heo31−5a

$\Delta Y/\Delta Y_u$ — IECsRGB tristimulus value difference ΔY normalized to ΔY_u

$\Delta Y/\Delta Y_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$dY=[Y_n/(n\,s)]\,(Y/Y_n)^{1-n}$ [2c]
$dY_u=[Y_n/(n\,s)]\,(Y_u/Y_n)^{1-n}=1,1746$ [2d]
$dY/dY_u=(Y/Y_u)^{1-n}$ [2e]

$m_{u90\_4}=0,021, f_{90}=2, f_4=0$
$m_u=0,027$

2,639
0,179

heo31−6a

log $[(\Delta Y/Y)/(\Delta Y/Y)_u]$ — IECsRGB-Y sensitivity normalized to $(\Delta Y/Y)_u$

$S_r/S_{ru}=(\Delta Y/Y)/(\Delta Y/Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$dY/Y=[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]/Y$ [3c]
$(dY/Y)_u=[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]/Y_u$ [3d]
$(dY/Y)/(dY/Y)_u=(Y/Y_u)^{-n}$ [3e]
$\log[(dY/Y)/(dY/Y)_u]=(-n)\,\log(Y/Y_u)$ [3f]

$m_{nu}=-n=-0,416$
$m_u=-0,416$

0,532
−0,301

heo30−7a
heo30−7n

log$[(Y/\Delta Y)/(Y/\Delta Y)_u]$ — IECsRGB-Y contrast normalized to $(Y/\Delta Y)_u$

$C_r/C_{ru}=(Y/\Delta Y)/(Y/\Delta Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$Y/dY=Y/\{[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]\}$ [4c]
$(Y/dY)_u=Y_u/\{[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]\}$ [4d]
$(Y/dY)/(Y/dY)_u=(Y/Y_u)^n$ [4e]
$\log[(Y/dY)/(Y/dY)_u]=(n)\,\log(Y/Y_u)$ [4f]

$m_{nu}=n=0,416$
$m_u=0,416$

0,301
−0,532

heo30−8a

$(\Delta Y/Y)/(\Delta Y/Y)_u$ — IECsRGB-Y sensitivity normalized to $(\Delta Y/Y)_u$

$S_r/S_{ru}=(\Delta Y/Y)/(\Delta Y/Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$dY/Y=[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]/Y$ [3c]
$(dY/Y)_u=[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]/Y_u$ [3d]
$(dY/Y)/(dY/Y)_u=(Y/Y_u)^{-n}$ [3e]

$m_{u90\_4}=-0,000, f_{90}=0, f_4=0$
$m_u=-0,001$

3,406
0,499

heo31−7a
heo31−7n

$(Y/\Delta Y)/(Y/\Delta Y)_u$ — IECsRGB-Y contrast normalized to $(Y/\Delta Y)_u$

$C_r/C_{ru}=(Y/\Delta Y)/(Y/\Delta Y)_u$

$L^*=s\,(Y/Y_n)^n-d$ $(Y_n=100, Y_u=18, s=100, n=1/2,4, d=0)$ [1a]
$L^*=r\,(Y/Y_u)^n-d$ $(r=s\,(Y_u/Y_n)^n=48,94, L^*_u=r-d)$ [1b]
$Y/dY=Y/\{[(Y_n/(n\,s))\,(Y/Y_n)^{1-n}]\}$ [4c]
$(Y/dY)_u=Y_u/\{[(Y_n/(n\,s))\,(Y_u/Y_n)^{1-n}]\}$ [4d]
$(Y/dY)/(Y/dY)_u=(Y/Y_u)^n$ [4e]

$m_{u90\_4}=0,336, f_{90}=39, f_4=10$
$m_u=0,457$

2,000
0,293

heo31−8a

application range

TUB-test chart heo3; CIELAB & IECsRGB colour-difference, ISO/CIE 11664-4 & IEC 61966-2-1

log & lin[lightness L^*, threshold ΔY, sensitivity $\Delta Y/Y$, contrast $Y/\Delta Y$, normalized for grey U]