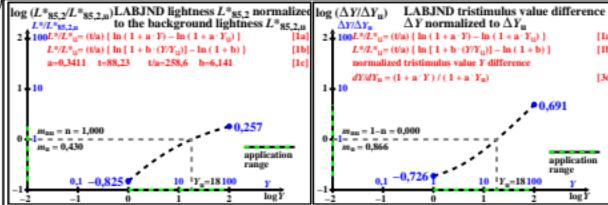


<http://farbe.li.tu-berlin.de/heo2/heo2l0n1.txt> /ps; only vector graphic VG; start output
see separate images of this page: <http://farbe.li.tu-berlin.de/heo2/heo2.htm>

See separate images of this page: [http://www.fccid.org/cid/](#)



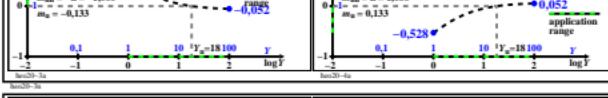
$$\log \left[(\Delta Y/Y) / (\Delta Y/Y)_u \right] = \text{LABJN} - S_e/S_{tu} = (\Delta Y/Y)/(\Delta Y/Y)_u$$

normalization

D-Y sensitivity related to $\langle \Delta Y \rangle_u$	$\log\left[\langle Y/\Delta Y \rangle / \langle Y/\Delta Y \rangle_u\right]$	LABJND-Y contrast normalized related to $\langle \Delta Y \rangle_u$
$1 + a \cdot \langle Y_U \rangle$	$C_{\text{D}} \cdot C_{\text{u}} = \langle Y/\Delta Y \rangle \langle Y/\Delta Y \rangle_u$	$C_{\text{D}} \cdot C_{\text{u}} = \langle Y/\Delta Y \rangle / \langle Y/\Delta Y \rangle_u$
$\ln(1 + b)$	$10^{0.4} \cdot L^{\ln(b)} = \ln(a) + \ln(1 + a \cdot \langle Y_U \rangle)$	$10^{0.4} \cdot L^{\ln(b)} = \ln(a) + \ln(1 + b \cdot \langle Y_U \rangle) - \ln(1 + a \cdot \langle Y_U \rangle)$
		$L^{\ln(b)} \cdot \langle Y_U \rangle = \ln(a) + \ln(1 + b \cdot \langle Y_U \rangle) - \ln(1 + a \cdot \langle Y_U \rangle)$

$$= [(1 + \alpha) Y / Y_0] / [(1 + \alpha) Y_0] = 0.528$$

$$\frac{1}{Y_u} = \frac{1}{(1 + u \cdot T)} \quad \text{and} \quad \frac{1}{Y_u} = \frac{1}{Y_u} \cdot \frac{1}{(1 + u \cdot T)} = \frac{1}{(1 + u \cdot T) \cdot Y_u}$$



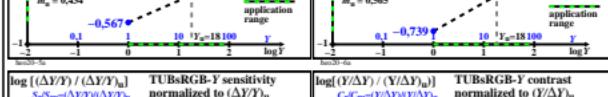
$$\log(L^*/L_u^*) = \text{TUBsRGB light} - \text{to the background}$$

L^*/L_u^*
 $\text{100}^{L^*/L_u^*} = (Y/Y_u)^{-d} - d$ ($Y_u=100$, $Y_u=18$)
 $L^* = r(Y/Y_u)^{-d} - d$ ($r = s(Y/Y_u)^{-d}$)
 $L^*/L_u^* = (Y/Y_u)^{\ln(10)} / (\ln(x) - \ln(10))$

$$\begin{aligned} \text{L}^* &= \text{normalized lightness} & L^*_{\text{u}} &= \text{unnormalized lightness} \\ \log(\Delta Y/\Delta Y_u) &= \text{TUBsRGB tristimulus value difference} & \Delta Y &= \text{normalized } \Delta Y_u \\ \Delta Y_{\text{u}} &= \text{unnormalized } \Delta Y_u & 100^{L^*} &= (Y/Y_u)^{1-d} \quad (Y_u=100, \gamma=18, n=100, d=0) [1a] \\ L^* = r & (Y/Y_u)^{1-d} & L^* = r & (Y/Y_u)^{1-d} \quad (r = s/(YY_u)^{1-d}, n=47, 48, L^*_{\text{u}}=r-d) [1b] \\ \log(X) &= \text{log}(X) & dY &= (Y_u/n) \times (Y/Y_u)^{1-n} \\ \end{aligned}$$

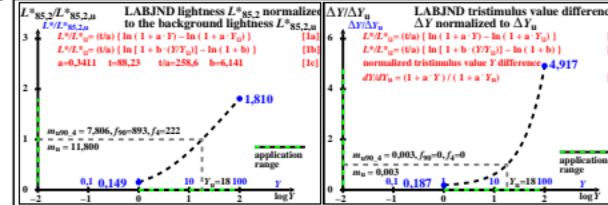
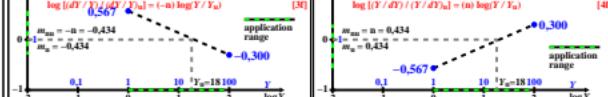
$$\frac{m_{\text{BH}}}{L^{\text{B}}/L^{\text{B}_0}} = n = 0.434$$

$$\begin{aligned} \text{[Id]} & \quad dY_u = Y_u' u \quad (Y_u' / Y_u)^{-n} = 1.0934 \\ \text{[Ie]} & \quad 1 - 10 \frac{dY_u}{dY_u'} = (Y_u' / Y_u)^{-n} \\ \text{[If]} & \quad \log(dY/dY_u) = (1-n) \log(Y'/Y_u) \end{aligned}$$



$$2 \quad \text{100}^{L^*} = s(Y/Y_u) - d \quad (Y_u=100, Y_w=18, \\ L^* = r(Y/Y_u)^a - d \quad (r=s(Y_w/Y_u)^{1-a}) \\ dY/Y = [(Y_u/(n+s))] (Y/Y_u)^{1-a} / \\ (dY/Y)_u = [(Y_u/(n+s))] (Y_u/Y_u)^{1-a} \\ 1 \quad \text{10} \quad (dY/Y) / (dY/Y)_u = (Y/Y_u)^{-a}$$

$$\begin{aligned}
& n=100, \quad n=1/\ln(10), \quad d=0.1 \\
& 7.48, L^{\infty} = r - d \quad (1a) \\
& 10^{100} = (Y/Y_0)^{-d} \quad (1b) \\
& Y = (Y/Y_0)^{1/d} \quad (1c) \\
& Y = s(Y/Y_0)^{1/d} - 47.48, L^{\infty} = r - d \quad (1d) \\
& Y/dY = Y' = \left\{ \left(\frac{1}{d} \left(Y/Y_0 \right)^{1/d} \right) \left(\frac{dY}{Y} \right) \right\}^{-1} \quad (1e) \\
& \left(Y/Y_0 \right)' = Y_0^{-1} \left(\left(\frac{1}{d} \left(Y/Y_0 \right)^{1/d} \right) \left(\frac{dY}{Y} \right) \right)^{-1} \quad (1f) \\
& 10 \cdot \left(Y'/dY \right) / \left(Y/Y_0 \right)' = \left(Y/Y_0 \right)^n \quad (1g)
\end{aligned}$$

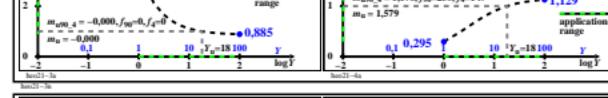


$(\Delta Y/Y) / (\Delta Y/Y)_u$ $S_x(S_{xy}) / (\Delta Y/Y)_u$	LABJND-Y sensitivity normalized to $(\Delta Y/Y)_u$
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$(Y/\Delta Y) / (Y/\Delta Y)_u$	LABJND-Y contrast normalized to $(Y/\Delta Y)_u$
$C_p/C_{pu} = (Y/\Delta Y)/(Y/\Delta Y)_u$	
$L^u/L^{pu} = (t/u) \{ \ln(1 + b \cdot Y) - \ln(1 + b \cdot Y_u) \}$	
$L^u/L^{pu} = (t/u) \{ \ln[1 + b \cdot (Y/Y_u)] - \ln(1 + b) \}$	

$$\begin{aligned} \text{trisodium vanide } Y \text{ sensitivity} \\ (dY/Y) / (dY_0/Y_0) \\ = [(1 + \alpha \cdot Y) / Y] / [(1 + \alpha \cdot Y_0) / Y_0] \quad [30] \\ 3,380 \end{aligned}$$

threshold value T contrast
 $(Y/dT) / (Y_{\text{th}}/d_{\text{th}})$
 $= [Y / (1 + \alpha \cdot Y)] / [Y_{\text{th}} / (1 + \alpha \cdot Y_{\text{th}})]$



$$\begin{aligned} & L^*/L_u \quad \text{TUBSRGB lightness } L^* \text{ normalized to} \\ & \text{the background lightness } L^*_u \\ 3 & \frac{L^*/L_u}{L^*/L_u} \\ & L^*/L_u = (Y/Y_u)^{0.8-d} \quad (Y_u=100, Y_r=18, s=100, n=1/\ln(10), d=0) [1a] \\ & L^*/L_u = r \cdot (Y/Y_u)^{0.8-d} \quad (r = s(Y/Y_u)^{-n} - 47.48, L^*_{u,r} = r - d) \quad [1b] \\ & L^*/L_u = (Y/Y_u)^{0.8-d} \quad (\ln(n)=\ln(10), \log(d)) \quad [1c] \end{aligned}$$

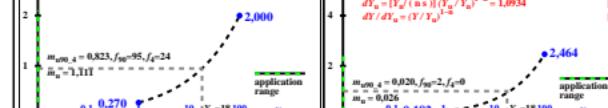
$$\Delta Y/\Delta Y_u = \text{TUBsRGB tristimulus value difference}$$

$$\Delta Y_u = \Delta Y \text{ normalized to } \Delta Y_u$$

$$L^u = s \cdot (Y/Y_u)^n - d \quad (Y_u=100, Y=18, s=100, n=1/\ln(10), d=0)$$

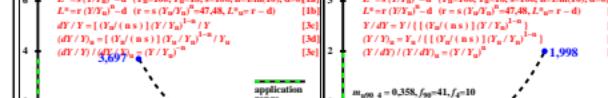
$$L^u = s \cdot (Y/Y_u)^n - d \quad (s = (Y_u/T_u)^{1/n} = 47.48, L^u = r - d)$$

$$dY = [Y_u / (n s)] \cdot (Y/Y_u)^{1-n}$$



$\Delta(Y)/Y$ / $(\Delta Y/Y)_u$ TUBsRGB-Y sensitivity
 $S_{TUBs} = \frac{\Delta(Y)/Y}{(\Delta Y/Y)_u}$ normalized to $(\Delta Y/Y)_u$

$(Y/\Delta Y) / (Y/\Delta Y)_u$ TUBsRGB-Y contrast
 $C_r/C_u = (Y/\Delta Y)/(Y/\Delta Y)_u$ normalized to $(Y/\Delta Y)_u$



TUB-test chart heo2; LABJND & TUBsRGB colour-difference, CIE 230:2019 & TUBsRGB 2025 log & lin[lightness L^* , threshold ΔY , sensitivity $\Delta Y / Y$, contrast $Y / \Delta Y$, normalized for grey U]