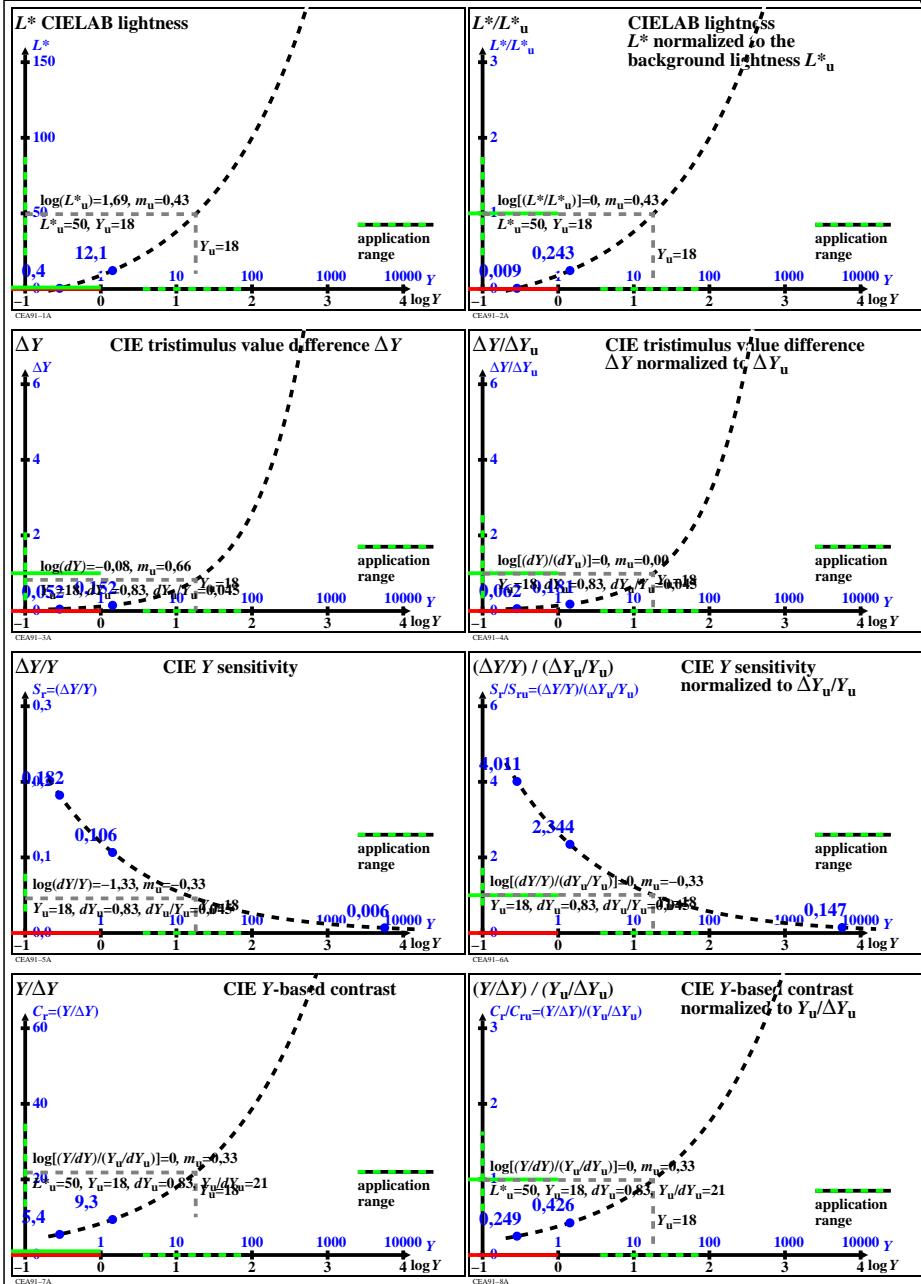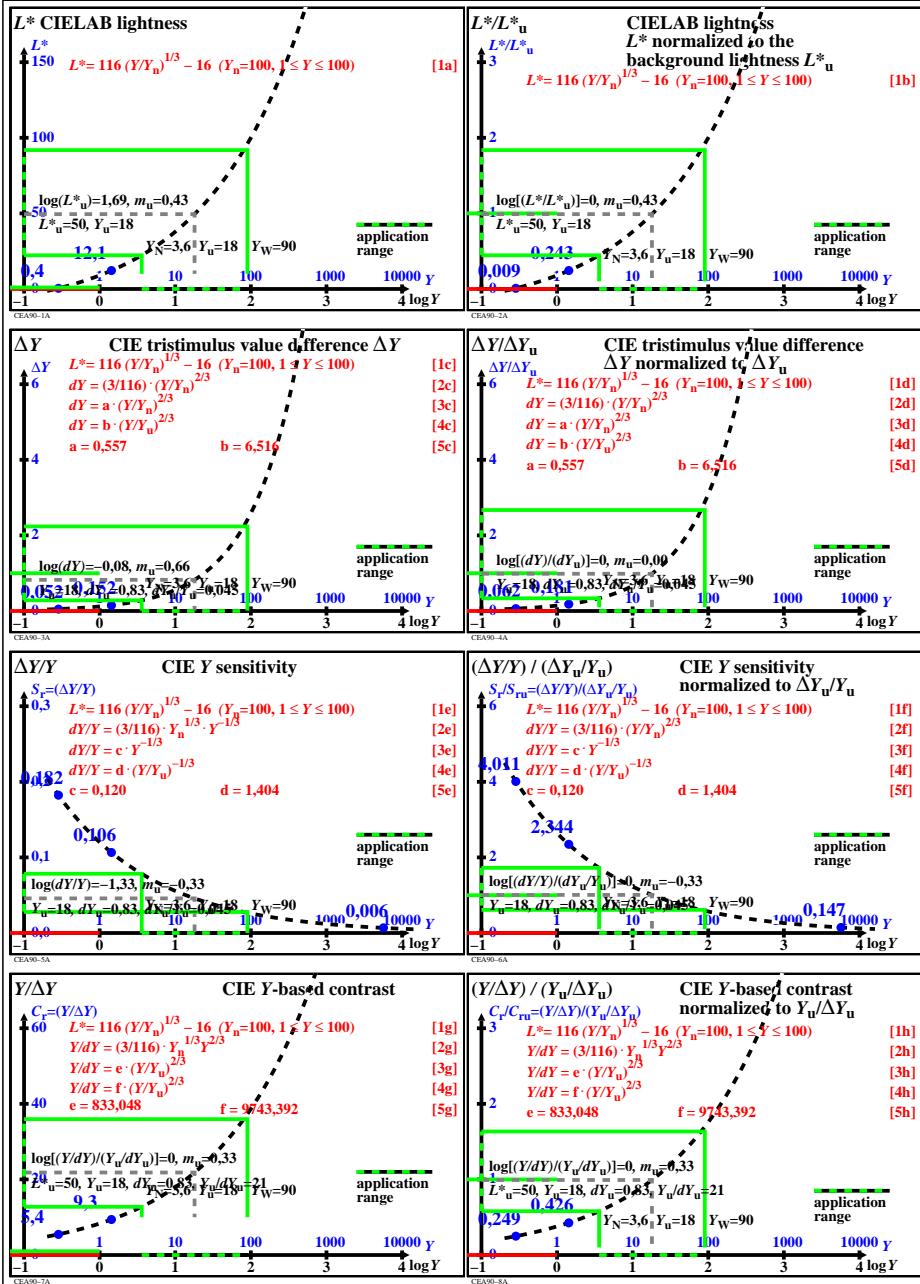see similar files: http://farbe.li.tu-berlin.de/CEA9/CEA9.HTM
technical information: http://farbe.li.tu-berlin.de or http://130.149.60.45/~farbmetrik

TUB registration: 20201101-CEA9/CEA9L0NP.PDF /.PS
application for evaluation and measurement of display or print output
TUB material: code=rha4ta

L* CIELAB lightness

$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1a]

L^*
150
100
log(L^*/L^*_u)=1,69, m_u=0,43
50
L^*_u=50, Y_u=18
12,1
0,4
Y_N=3,6 Y_u=18 Y_W=90
application range
−1 0 1 2 3 4 log Y
1 10 100 1000 10000 Y
CEA90−1A

CIELAB lightness
L* normalized to the background lightness L*_u

$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1b]

L^*/L^*_u
3
2
log[(L^*/L^*_u)]=0, m_u=0,43
L^*_u=50, Y_u=18
0,243
0,009
Y_N=3,6 Y_u=18 Y_W=90
application range
CEA90−2A

L* CIELAB lightness

L^*
150
100
log(L^*_u)=1,69, m_u=0,43
50
L^*_u=50, Y_u=18
12,1
0,4
application range
CEA91−1A

CIELAB lightness
L* normalized to the background lightness L*_u

L^*/L^*_u
3
2
log[(L^*/L^*_u)]=0, m_u=0,43
L^*_u=50, Y_u=18
0,243
0,009
Y_u=18
application range
CEA91−2A

ΔY **CIE tristimulus value difference ΔY**

$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1c]
$dY = (3/116) · (Y/Y_n)^{2/3}$ [2c]
$dY = a · (Y/Y_n)^{2/3}$ [3c]
$dY = b · (Y/Y_u)^{2/3}$ [4c]
a = 0,557   b = 6,516 [5c]

$ΔY$
6
4
2
log(dY)=−0,08, m_u=0,66
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
application range
CEA90−3A

ΔY/ΔY_u **CIE tristimulus value difference ΔY normalized to ΔY_u**

$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1d]
$dY = (3/116) · (Y/Y_n)^{2/3}$ [2d]
$dY = a · (Y/Y_u)^{2/3}$ [3d]
$dY = b · (Y/Y_u)^{2/3}$ [4d]
a = 0,557   b = 6,516 [5d]

$ΔY/ΔY_u$
6
4
2
log[(dY)/(dY_u)]=0, m_u=0,00
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
application range
CEA90−4A

ΔY **CIE tristimulus value difference ΔY**

$ΔY$
6
4
2
log(dY)=−0,08, m_u=0,66
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
application range
CEA91−3A

ΔY/ΔY_u **CIE tristimulus value difference ΔY normalized to ΔY_u**

$ΔY/ΔY_u$
6
4
2
log[(dY)/(dY_u)]=0, m_u=0,00
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
application range
CEA91−4A

ΔY/Y **CIE Y sensitivity**

$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1e]
$dY/Y = (3/116) · Y_n^{1/3} · Y^{−1/3}$ [2e]
$dY/Y = c · Y^{−1/3}$ [3e]
$dY/Y = d · (Y/Y_u)^{−1/3}$ [4e]
c = 0,120   d = 1,404 [5e]

$S_r=(ΔY/Y)$
0,3
0,182
0,106
0,1
log(dY/Y)=−1,33, m_u=0,33
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
0,006
application range
CEA90−5A

(ΔY/Y) / (ΔY_u/Y_u) **CIE Y sensitivity normalized to ΔY_u/Y_u**

$S_r/S_{ru}=(ΔY/Y_u)/(ΔY_u/Y_u)$
$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1f]
$dY/Y = (3/116) · (Y/Y_n)^{2/3}$ [2f]
$dY/Y = c · Y^{−1/3}$ [3f]
$dY/Y = d · (Y/Y_u)^{−1/3}$ [4f]
c = 0,120   d = 1,404 [5f]

6
4,011
4
2,344
2
log[(dY/Y)/(dY_u/Y_u)]=0, m_u=−0,33
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
0,147
application range
CEA90−6A

ΔY/Y **CIE Y sensitivity**

$S_r=(ΔY/Y)$
0,3
0,182
0,106
0,1
log(dY/Y)=−1,33, m_u=0,33
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
0,006
application range
CEA91−5A

(ΔY/Y) / (ΔY_u/Y_u) **CIE Y sensitivity normalized to ΔY_u/Y_u**

$S_r/S_{ru}=(ΔY/Y)/(ΔY_u/Y_u)$
6
4,011
4
2,344
2
log[(dY/Y)/(dY_u/Y_u)]=0, m_u=−0,33
Y_u=18, dY_u=0,83, dY_u/Y_u=0,048
0,147
application range
CEA91−6A

Y/ΔY **CIE Y-based contrast**

$C_r=(Y/ΔY)$
60
$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1g]
$Y/dY = (3/116) · Y_n^{1/3} Y^{2/3}$ [2g]
$Y/dY = e · (Y/Y_u)^{2/3}$ [3g]
$Y/dY = f · (Y/Y_u)^{2/3}$ [4g]
e = 833,048   f = 9743,392 [5g]
40
20
log[(Y/dY)/(Y_u/dY_u)]=0, m_u=0,33
L^*_u=50, Y_u=18, dY_u=0,83, Y_u/dY_u=21
9,3
5,4
Y_N=3,6 Y_u=18 Y_W=90
0,426
application range
CEA90−7A
CEA90−7N

(Y/ΔY) / (Y_u/ΔY_u) **CIE Y-based contrast normalized to Y_u/ΔY_u**

$C_r/C_{ru}=(Y/ΔY)/(Y_u/ΔY_u)$
3
$L^*= 116 (Y/Y_n)^{1/3} − 16$ $(Y_n=100, 1 ≤ Y ≤ 100)$ [1h]
$Y/dY = (3/116) · Y_n^{1/3} Y^{2/3}$ [2h]
$Y/dY = e · (Y/Y_u)^{2/3}$ [3h]
$Y/dY = f · (Y/Y_u)^{2/3}$ [4h]
e = 833,048   f = 9743,392 [5h]
2
log[(Y/dY)/(Y_u/dY_u)]=0, m_u=0,33
L^*_u=50, Y_u=18, dY_u=0,83, Y_u/dY_u=21
0,426
0,249
Y_N=3,6 Y_u=18 Y_W=90
application range
CEA90−8A

Y/ΔY **CIE Y-based contrast**

$C_r=(Y/ΔY)$
60
40
20
log[(Y/dY)/(Y_u/dY_u)]=0, m_u=0,33
L^*_u=50, Y_u=18, dY_u=0,83, Y_u/dY_u=21
9,3
5,4
application range
CEA91−7A

(Y/ΔY) / (Y_u/ΔY_u) **CIE Y-based contrast normalized to Y_u/ΔY_u**

$C_r/C_{ru}=(Y/ΔY)/(Y_u/ΔY_u)$
3
2
log[(Y/dY)/(Y_u/dY_u)]=0, m_u=0,33
L^*_u=50, Y_u=18, dY_u=0,83, Y_u/dY_u=21
0,426
0,249
Y_u=18
application range
CEA91−8A

TUB-test chart CEA9; For CIELAB colour-difference formula, see ISO/CIE 11664-4
lightness L*, threshold ΔY, sensitivity ΔY / Y, contrast Y / ΔY, unnormalized and normalized