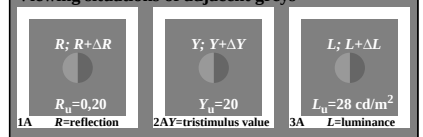
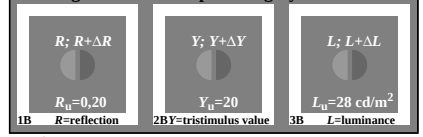
sensation scaling functions
lightness L^* and tristimulus value Y
adaptation on surround white W
$L^*_W = 100\,(\,Y\,/\,100)^{1/2,0}$
adaptation on surround grey Z
$L^*_Z = 100\,(\,Y\,/\,100)^{1/2,4}$
description with CIELAB 1976
$L^*_{CIELAB} = 116\,(\,Y\,/\,100)^{1/3,0} - 16$
adaptation on surround black N
$L^*_N = 100\,(\,Y\,/\,100)^{1/3,0}$

BEU50−1N

Viewing situations of adjacent greys



Viewing situations of separated greys



BEU50−2N

Lightness L^*_Z for surround mean grey Z (sRGB)
For separated surface colours in the range 3,6<L<90
or the digital range 100/255=0,39<L<100 it is valid:
$L^*_Z = a\,(L/L_n)^k$ [1] a=100; L_n=142cd/m²; k=0,42
$= b\,(L/L_u)^k$ [2] b=a(L_u/L_n)^k=50; L_u=18
For L=L_u it is valid: L^*_{Zu}=50.

Derivation of equation [2] gives with **1−k = 0,58:**
$\delta(L^*_Z)/\delta L = c\,(L/L_u)^{1-k}$ [3] $c = (b\,k)/L_u$ = 21/18 = 1,17
or for the treshold $\delta(L^*_Z)$=1
$\delta L = d\,(L/L_u)^{1-k}$ [4] $d = L_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Zu} = 50 with L=L_u is the threshold:
δL_{Zu} = 0,86. This threshold is *independent* of k.

BEU51−1N

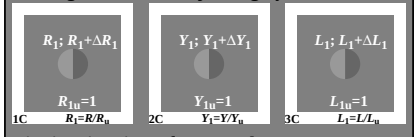
Lightness L^*_{JND} for the Just Noticeable Difference (JND)
For adjacent surface colours in the range 3,6<L<90
or the digital range 100/255=0,39<L<100 it is valid:
$L^*_{JND} = a\,(L/L_u)^k$ [1] a=572; L_n=142cd/m²; k=0,14
$= b\,(L/L_u)^k$ [2] b=a(L_u/L_n)^k=450; L_u=18
For L=L_u it is valid: L^*_{JNDu}=450.

Derivation of equation [2] gives with **1−k = 0,86:**
$\delta(L^*_{JND})/\delta L = c\,(L/L_u)^{1-k}$ [3] $c = (b\,k)/L_u$ = 63/18 = 3,5
or for the treshold $\delta(L^*_{JND})$=1
$\delta L = d\,(L/L_u)^{1-k}$ [4] $d = L_u/(b\,k)$ = 18/63 = 0,29

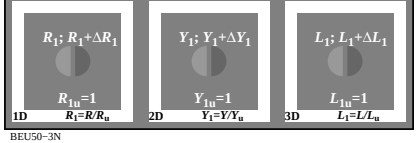
For the surround lightness L^*_{JNDu}=450 with L=L_u the threshold is
δL_{JNDu} = 0,29. This threshold is *independent* of k.

BEU51−2N

Viewing situations of adjacent greys

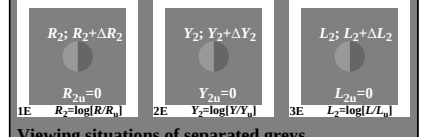


Viewing situations of separated greys

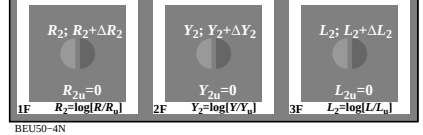


BEU50−3N

Viewing situations of adjacent greys



Viewing situations of separated greys



BEU50−4N

Lightness L^*_N for surround black N
For separated surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:
$L^*_N = a\,(R/R_n)^k$ [1] a=100; R_n=1,00; k=0,33=1/3,0
$= b\,(R/R_u)^k$ [2] b=a(R_u/R_n)^k=56; R_u=0,18
For R=R_u it is valid: L^*=56.

Derivation of equation [2] gives with **1−k = 0,67:**
$\delta(L^*_N)/\delta R = c\,(R/R_u)^{1-k}$ [3] $c = (b\,k)/R_u$ = 19/18 = 1,05
or for the threshold $\delta(L^*_N)$=1
$\delta R = d\,(R/R_u)^{1-k}$ [4] $d = R_u/(b\,k)$ = 18/19 = 0,95

For the surround lightness L^*_{Nu} = 50 with R=R_u the threshold is:
δR_{Nu} = 0,95. This threshold is *independent* of k.

BEU51−3N

Lightness L^*_W for surround white W
For separated surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:
$L^*_W = a\,(R/R_W)^k$ [1] a=100; R_W=1,00; k=0,50=1/2,0
$= b\,(R/R_u)^k$ [2] b=a(R_u/R_W)^k=42; R_u=0,18
For R=R_u it is valid: L^*=42.

Derivation of equation [2] gives with **1−k = 0,50:**
$\delta(L^*_W)/\delta R = c\,(R/R_u)^{1-k}$ [3] $c = (b\,k)/R_u$ = 21/18 = 1,17
or for the threshold $\delta(L^*_W)$=1
$\delta R = d\,(R/R_u)^{1-k}$ [4] $d = R_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Wu} = 50 with R=R_u the threshold is:
δR_{Wu} = 0,86. This threshold is *independent* of k.

BEU51−4N

Lightness L^*_Z for surround mean grey Z (sRGB)
For separated surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:
$L^*_Z = a\,(R/R_n)^k$ [1] a=100; R_n=1,00; k=0,42=1/2,4
$= b\,(R/R_u)^k$ [2] b=a(R_u/R_n)^k=50; R_u=0,18
For R=R_u it is valid: L^*_{Zu}=50.

Derivation of equation [2] gives with **1−k = 0,58:**
$\delta(L^*_Z)/\delta R = c\,(R/R_u)^{1-k}$ [3] $c = (b\,k)/R_u$ = 21/18 = 1,17
or for the threshold $\delta(L^*_Z)$=1
$\delta R = d\,(R/R_u)^{1-k}$ [4] $d = R_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Zu} = 50 with R=R_u the threshold is:
δR_{Zu} = 0,86. This threshold is *independent* of k.

BEU50−5N

Lightness L^*_{JND} for the Just Noticeable Difference (JND)
For adjacent surface colours in the range 0,0036<R<0,90
or the digital range 1/255=0,0039<R<1,00 it is valid:
$L^*_{JND} = a\,(R/R_n)^k$ [1] a=572; R_n=1,00; k=0,14=1/7,2
$= b\,(R/R_u)^k$ [2] b=a(R_u/R_n)^k=450; R_u=0,18
For R=R_u it is valid: L^*_{JNDu}=450.

Derivation of equation [2] gives with **1−k = 0,86:**
$\delta(L^*_{JND})/\delta R = c\,(R/R_u)^{1-k}$ [3] $c = (b\,k)/R_u$ = 63/18 = 3,5
or for the treshold $\delta(L^*_{JND})$=1
$\delta R = d\,(R/R_u)^{1-k}$ [4] $d = R_u/(b\,k)$ = 18/63 = 0,29

For the surround lightness L^*_{JNDu}=450 with R=R_u the threshold is
δR_{JNDu} = 0,29. This threshold is *independent* of k.

BEU50−6N

Lightness L^*_N for surround black N
For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:
$L^*_N = a\,(Y/Y_n)^k$ [1] a=100; Y_n=100; k=0,33=1/3,0
$= b\,(Y/Y_u)^k$ [2] b=a(Y_u/Y_n)^k=56; Y_u=18
For Y=Y_u it is valid: L^*=56.

Derivation of equation [2] gives with **1−k = 0,67:**
$\delta(L^*_N)/\delta Y = c\,(Y/Y_u)^{1-k}$ [3] $c = (b\,k)/Y_u$ = 19/18 = 1,05
or for the treshold $\delta(L^*_N)$=1
$\delta Y = d\,(Y/Y_u)^{1-k}$ [4] $d = Y_u/(b\,k)$ = 18/19 = 0,95

For the surround lightness L^*_{Nu} = 50 with Y=Y_u the threshold is:
δY_{Nu} = 0,95. This threshold is *independent* of k.

BEU51−5N

Lightness L^*_W for surround white W
For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:
$L^*_W = a\,(Y/Y_W)^k$ [1] a=100; Y_W=100; k=0,50=1/2,0
$= b\,(Y/Y_u)^k$ [2] b=a(Y_u/Y_W)^k=42; Y_u=18
For Y=Y_u it is valid: L^*=42.

Derivation of equation [2] gives with **1−k = 0,50:**
$\delta(L^*_W)/\delta Y = c\,(Y/Y_u)^{1-k}$ [3] $c = (b\,k)/Y_u$ = 21/18 = 1,17
or for the treshold $\delta(L^*_W)$=1
$\delta Y = d\,(Y/Y_u)^{1-k}$ [4] $d = Y_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Wu} = 50 with Y=Y_u the threshold is:
δY_{Wu} = 0,86. This threshold is *independent* of k.

BEU51−6N

Lightness L^*_Z for surround mean grey Z (sRGB)
For separated surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:
$L^*_Z = a\,(Y/Y_n)^k$ [1] a=100; Y_n=100; k=0,42=1/2,4
$= b\,(Y/Y_u)^k$ [2] b=a(Y_u/Y_n)^k=50; Y_u=18
For Y=Y_u it is valid: L^*_{Zu}=50.

Derivation of equation [2] gives with **1−k = 0,58:**
$\delta(L^*_Z)/\delta Y = c\,(Y/Y_u)^{1-k}$ [3] $c = (b\,k)/Y_u$ = 21/18 = 1,17
or for the threshold $\delta(L^*_Z)$=1
$\delta Y = d\,(Y/Y_u)^{1-k}$ [4] $d = Y_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Zu} = 50 with Y=Y_u the threshold is:
δY_{Zu} = 0,86. This threshold is *independent* of k.

BEU50−7N

Lightness L^*_{JND} for the Just Noticeable Difference (JND)
For adjacent surface colours in the range 3,6<Y<90
or the digital range 100/255=0,39<Y<100 it is valid:
$L^*_{JND} = a\,(Y/Y_n)^k$ [1] a=572; Y_n=100; k=0,14=1/7,2
$= b\,(Y/Y_u)^k$ [2] b=a(Y_u/Y_n)^k=450; Y_u=18
For Y=Y_u it is valid: L^*_{JNDu}=450.

Derivation of equation [2] gives with **1−k = 0,86:**
$\delta(L^*_{JND})/\delta Y = c\,(Y/Y_u)^{1-k}$ [3] $c = (b\,k)/Y_u$ = 63/18 = 3,5
or for the treshold $\delta(L^*_{JND})$=1
$\delta Y = d\,(Y/Y_u)^{1-k}$ [4] $d = Y_u/(b\,k)$ = 18/63 = 0,29

For the surround lightness L^*_{JNDu}=450 with Y=Y_u the threshold is:
δY_{JNDu} = 0,29. This threshold is *independent* of k.

BEU50−8N

Lightness L^*_N for surround black N
For adjacent surface colours in the range 3,6<L<90
or the digital range 100/255=0,39<L<100 it is valid:
$L^*_N = a\,(L/L_n)^k$ [1] a=100; L_n=142cd/m²; k=0,33
$= b\,(L/L_u)^k$ [2] b=a(L_u/L_n)^k=56; L_u=18
For L=L_u it is valid: L^*=56.

Derivation of equation [2] gives with **1−k = 0,67:**
$\delta(L^*_N)/\delta L = c\,(L/L_u)^{1-k}$ [3] $c = (b\,k)/L_u$ = 19/18 = 1,05
or for the treshold $\delta(L^*_N)$=1
$\delta L = d\,(L/L_u)^{1-k}$ [4] $d = L_u/(b\,k)$ = 18/19 = 0,95

For the surround lightness L^*_{Nu} = 50 with L=L_u the threshold is:
δL_{Nu} = 0,95. This threshold is *independent* of k.

BEU51−7N

Lightness L^*_W for surround white W
For adjacent surface colours in the range 3,6<L<90
or the digital range 100/255=0,39<L<100 it is valid:
$L^*_W = a\,(L/L_W)^k$ [1] a=100; L_W=142cd/m²; k=0,50
$= b\,(L/L_u)^k$ [2] b=a(L_u/L_W)^k=42; L_u=18
For L=L_u it is valid: L^*=42.

Derivation of equation [2] gives with **1−k = 0,50:**
$\delta(L^*_W)/\delta L = c\,(L/L_u)^{1-k}$ [3] $c = (b\,k)/L_u$ = 21/18 = 1,17
or for the threshold $\delta(L^*_W)$=1
$\delta L = d\,(L/L_u)^{1-k}$ [4] $d = L_u/(b\,k)$ = 18/21 = 0,86

For the surround lightness L^*_{Wu} = 50 with L=L_u the threshold is:
δL_u = 0,86. This threshold is *independent* of k.

BEU51−8N