sensation scaling functions
lightness *L and tristimulus value *Y***

adaptation on surround white *W*
$L^*_W = 100\ (Y/100)^{1/2{,}0}$

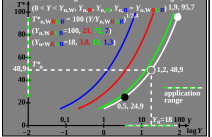
adaptation on surround grey *U*
$L^*_U = 100\ (Y/100)^{1/2{,}4}$

description with CIELAB 1976
$L^*_{CIELAB} = 116\ (Y/100)^{1/3{,}0} - 16$

adaptation on surround black *N*
$L^*_N = 100\ (Y/100)^{1/3{,}0}$

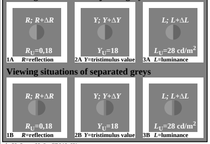
fea30−1a, eea00−4n, CEA10−4N

IECsRGB-triangle lightness *T as function of log*Y***
coordinates *T and log*Y* for 4 colours *WRGB***



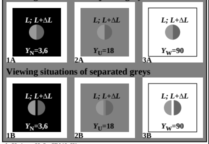
fea30−2a, eer31−4n

Viewing situations of adjacent greys



fea30−3a, eea00−2n, CEA10−2N

Viewing situations of adjacent greys



fea30−4a, eea00−3n, CEA10−3N

fea30−3n

Dynamic range conversion of images with equally spaced *rgb data**
Equally spaced visual output and lightness *L output with *GammaAdjuster***

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
equally spaced
$rgb^*_N=0$, $L^*_N=18$, $Y_N=2{,}5$
$rgb^*_W=1$, $L^*_W=95$, $Y_W=90$
$\Delta L^*=5$, $\gamma_{rel}=1{,}0$, $\gamma_{rel,i}=1{,}0$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to 16 test-chart pages according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0PX.PDF, flower motiv with $0{,}5 <= \gamma_{rel} <= 1$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0NX.PDF, flower motiv with $1 <= \gamma_{rel} <= 2$.
and similar for the ISO series AE49, AE09, AE28 instead of AE18, see
https://standards.iso.org/iso/9241/306/ed-2/index.html.

fea30−5a

Dynamic range conversion of images with equally spaced *rgb data**
Equally spaced visual output and lightness *L output with *GammaAdjuster***

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
not equally spaced
$rgb^*_N=0$, $L^*_N=36$, $Y_N=9$
$rgb^*_W=1$, $L^*_W=88$, $Y_W=71$
$\Delta L^*=3$, $\gamma_{rel}=0{,}8$, $_{rel,i}=1{,}3$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to 16 test-chart pages according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0PX.PDF, flower motiv with $0{,}5 <= \gamma_{rel} <= 1$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0NX.PDF, flower motiv with $1 <= \gamma_{rel} <= 2$.
and similar for the ISO series AE49, AE09, AE28 instead of AE18, see
https://standards.iso.org/iso/9241/306/ed-2/index.html.

fea30−6a

Visual definition of γ_{rel} by test-chart output on display
according to ISO 9241-306 with 16 values $0{,}5 <= \gamma_{rel} <= 2$

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
equally spaced
$rgb^*_N=0$, $L^*_N=18$, $Y_N=2{,}5$
$rgb^*_W=1$, $L^*_W=95$, $Y_W=90$
$\Delta L^*=5$, $\gamma_{rel}=1{,}0$, $\gamma_{rel,i}=1{,}0$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to one test-chart page according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$:
http://farbe.li.tu-berlin.de/eec4/eec4l0np.pdf, 1080 colors including 729(9x9x9) colors.
http://farbe.li.tu-berlin.de/eec6/eec6l0np.pdf, flower motiv, slide film, +0,5 stops.
http://farbe.li.tu-berlin.de/eec7/eec7l0np.pdf, flower motiv, negative film, +2 stops.
see for papers: https://farbe.li.tu-berlin.de/XY91FEN.html.

fea30−7a

Visual definition of γ_{rel} by test-chart output on display
according to ISO 9241-306 with 16 values $0{,}5 <= \gamma_{rel} <= 2$

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
not equally spaced
$rgb^*_N=0$, $L^*_N=36$, $Y_N=9$
$rgb^*_W=1$, $L^*_W=88$, $Y_W=71$
$\Delta L^*=3$, $\gamma_{rel}=0{,}8$, $_{rel,i}=1{,}3$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to one test-chart page according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$:
http://farbe.li.tu-berlin.de/eec4/eec4l0np.pdf, 1080 colors including 729(9x9x9) colors.
http://farbe.li.tu-berlin.de/eec6/eec6l0np.pdf, flower motiv, slide film, +0,5 stops.
http://farbe.li.tu-berlin.de/eec7/eec7l0np.pdf, flower motiv, negative film, +2 stops.
see for papers: https://farbe.li.tu-berlin.de/XY91FEN.html.

fea30−8a

fea30−7n

Dynamic range conversion of images with equally spaced *rgb data**
Equally spaced visual output and lightness *L output with *GammaAdjuster***

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
equally spaced
$rgb^*_N=0$, $L^*_N=18$, $Y_N=2{,}5$
$rgb^*_W=1$, $L^*_W=95$, $Y_W=90$
$\Delta L^*=5$, $\gamma_{rel}=1{,}0$, $\gamma_{rel,i}=1{,}0$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to 16 test-chart pages according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0PX.PDF, flower motiv with $0{,}5 <= \gamma_{rel} <= 1$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0NX.PDF, flower motiv with $1 <= \gamma_{rel} <= 2$.
and similar for the ISO series AE49, AE09, AE28 instead of AE18, see
https://standards.iso.org/iso/9241/306/ed-2/index.html.

fea31−1a

Dynamic range conversion of images with equally spaced *rgb data**
Equally spaced visual output and lightness *L output with *GammaAdjuster***

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

HDR display
HDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
not equally spaced
$rgb^*_N=0$, $L^*_N=10?$
$rgb^*_W=1$, $L^*_W=160?$
$\Delta L^*=10$ $\gamma_{rel}=1{,}3$, $_{rel,i}=0{,}8$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to 16 test-chart pages according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0PX.PDF, flower motiv with $0{,}5 <= \gamma_{rel} <= 1$.
https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0NX.PDF, flower motiv with $1 <= \gamma_{rel} <= 2$.
and similar for the ISO series AE49, AE09, AE28 instead of AE18, see
https://standards.iso.org/iso/9241/306/ed-2/index.html.

fea31−2a

Visual definition of γ_{rel} by test-chart output on display
according to ISO 9241-306 with 16 values $0{,}5 <= \gamma_{rel} <= 2$

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

SDR display
SDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
equally spaced
$rgb^*_N=0$, $L^*_N=18$, $Y_N=2{,}5$
$rgb^*_W=1$, $L^*_W=95$, $Y_W=90$
$\Delta L^*=5$, $\gamma_{rel}=1{,}0$, $\gamma_{rel,i}=1{,}0$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to one test-chart page according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$:
http://farbe.li.tu-berlin.de/eec4/eec4l0np.pdf, 1080 colors including 729(9x9x9) colors.
http://farbe.li.tu-berlin.de/eec6/eec6l0np.pdf, flower motiv, slide film, +0,5 stops.
http://farbe.li.tu-berlin.de/eec7/eec7l0np.pdf, flower motiv, negative film, +2 stops.
see for papers: https://farbe.li.tu-berlin.de/XY91FEN.html.

fea31−3a

Visual definition of γ_{rel} by test-chart output on display
according to ISO 9241-306 with 16 values $0{,}5 <= \gamma_{rel} <= 2$

raw image data (8bit)
0<= *rgb* <=1 (PhotoCD)
not equally spaced
search 0<= rgb_N <=1,
and 0<= rgb_W <=1

16 grey steps
ISO/IEC 15775
ISO 9241-306
standard range

Gamma Adjuster $(rgb^*)^{\gamma_{rel}}$
$\gamma_{rel}=\gamma/2{,}4$
$1{,}2<=\gamma<=4{,}8$

HDR display
HDR range

visual image (8bit)
0 <= *rgb** <= 1
equally spaced between
$rgb^*_N=0$ and $rgb^*_W=1$
$L^*_N=18$ and $L^*_W=95$
$\Delta(rgb^*)=1/15$, $\Delta L^*=5$

Baseline image
0 <= *rgb** <= 1
equally spaced
$rgb^*_N=0$, $L^*_N=18$
$rgb^*_W=1$, $L^*_W=95$
$\Delta L^*=5$

apply
γ_{rel}
$\gamma_{rel,i}=1/\gamma_{rel}$
i=invers

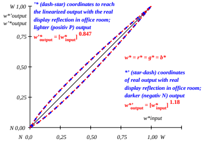
Alternate image
$0 <= (rgb^*)^{\gamma_{rel,i}} <= 1$
not equally spaced
$rgb^*_N=0$, $L^*_N=10?$
$rgb^*_W=1$, $L^*_W=160?$
$\Delta L^*=10$ $\gamma_{rel}=1{,}3$, $_{rel,i}=0{,}8$

Determine visually the value of γ_{rel} in the range $0{,}5 <= \gamma_{rel} <= 2$ with the following two test charts.
Links to one test-chart page according to ISO 9241-306 with $0{,}5 <= \gamma_{rel} <= 2$:
http://farbe.li.tu-berlin.de/eec4/eec4l0np.pdf, 1080 colors including 729(9x9x9) colors.
http://farbe.li.tu-berlin.de/eec6/eec6l0np.pdf, flower motiv, slide film, +0,5 stops.
http://farbe.li.tu-berlin.de/eec7/eec7l0np.pdf, flower motiv, negative film, +2 stops.
see for papers: https://farbe.li.tu-berlin.de/XY91FEN.html.

fea31−4a

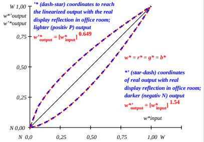
fea31−3n

For linearized output of the 16 grey steps according to ISO 9241-306



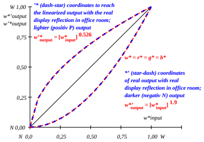
fea31−5A

For linearized output of the 16 grey steps according to ISO 9241-306



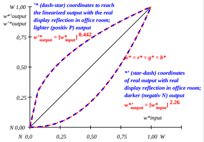
fea31−5A

For linearized output of the 16 grey steps according to ISO 9241-306



fea31−5A

For linearized output of the 16 grey steps according to ISO 9241-306



fea31−5A

fea31−7n

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

TUB registration: 20230801-fea3/fea3l0n1.txt /.ps
application for evaluation and measurement of display or print output

TUB material: code=rha4ta