Contrast steps C_{Yi} (i=1 to 8), CIE tristimulues values Y_W and Y_N according to ISO 9241−306[1)]

Contrast step C_{Yi} and Y-ratio (i=1 .. 8)	CIE tristimulus values; Ratio $Y_W : Y_N$ of White W and Black N	CIE tristimulus values; Range Y_{N1} ... Y_{N2}	Display (E) illuminance[2)]; Ratio [lux] $E_{WE} : E_{NE}$	Display (E) luminance[2)]; Ratio [cd/m²] $L_{WE} : L_{NE}$	application and colour mode at work place; illuminance on display 500 lux or 250/125/62 lux
C_{Y8} **288:1**	88,9 : 0,31	0,00 ... <0,46	445 : 1,55	142 : 0,50	display, only 062 lux
C_{Y7} **144:1**	88,9 : 0,62	0,46 ... <0,93	445 : 3,1	142 : 1,00	display, only 125 lux
C_{Y6} **72:1**	88,9 : 1,25	0,93 ... <1,87	445 : 6,2	142 : 2,00	display, only 250 lux
C_{Y5} **36:1**	**88,9 : 2,50**	**1,87 ... <3,75**	**445 : 12,4**	**142 : 4,00**	**display & surface**
C_{Y4} **18:1**	88,9 : 5,00	3,75 ... <7,50	445 : 24,8	142 : 8,00	display & surface
C_{Y3} **9:1**	88,9 : 10,0	7,50 ... <15,0	445 : 49,6	142 : 16,0	display & surface
C_{Y2} **4,5:1**	88,9 : 20,0	15,0 ... <30,0	445 : 99,2	142 : 32,0	display & surface
C_{Y1} **2,2:1[3)]**	88,9 : 40,0	30,0 ... <60,0	445 : 198	142 : 64,0	display & surface

1) The example shows data for emissive displays (E). The standard contrast step (bold) with L_{NE}= 4 cd/m² may be reached.
2) Measurement of 445 (= 500*0,889) lux corresponds to the viewing luminance L_v=142 cd/m² for an emmissive display (E).
3) For the contrast C_Y =36:1 the viewing luminances of both the black paper and the black on the screen are equal.
Also the viewing luminances of all colours at the screen and the paper are equal, for example for a 16 step grey scale.
A visual fatique based on an adaptation changes between paper and display is unpossible
For all black surfaces it is valid **Y_N>=2,5.** Therefore high contrast steps are only possible at the displays by reduced reflection.

PS030−3N

Contrast steps C_{Yi} (i=1 to 8), CIE tristimulues values Y_W and Y_N according to ISO 9241−306[1)]

Contrast step C_{Yi} and Y-ratio (i=1 .. 8)	CIE tristimulus values; Ratio $Y_W : Y_N$ of White W and Black N	CIE tristimulus values; Range Y_{N1} ... Y_{N2}	Paper (S) luminance[2)]; Ratio [cd/m²] $L_{WS} : L_{NS}$	Display (P) luminance[2)]; Ratio [cd/m²] $L_{WP} : L_{NP}$	application and colour mode at work place; illuminance on display 500 lux or 250/125/62 lux
C_{Y8} **288:1**	88,9 : 0,31	0,00 ... <0,46	142 : 142/288	142*36 : 018	display, only 062 lux
C_{Y7} **144:1**	88,9 : 0,62	0,46 ... <0,93	142 : 142/144	142*36 : 035	display, only 125 lux
C_{Y6} **72:1**	88,9 : 1,25	0,93 ... <1,87	142 : 142/72	142*36 : 071	display, only 250 lux
C_{Y5} **36:1**	**88,9 : 2,50**	**1,87 ... <3,75**	**142 : 142/36**	**142*36 : 142**	**display & surface**
C_{Y4} **18:1**	88,9 : 5,00	3,75 ... <7,50	142 : 142/18	142*18 : 142	display & surface
C_{Y3} **9:1**	88,9 : 10,0	7,50 ... <15,0	142 : 142/09	142*09 : 142	display & surface
C_{Y2} **4,5:1**	88,9 : 20,0	15,0 ... <30,0	142 : 142/4,5	142*4,5 : 142	display & surface
C_{Y1} **2,2:1[3)]**	88,9 : 40,0	30,0 ... <60,0	142 : 142/2,25	142*2,25 : 142	display & surface

1) The example shows data for data projectors (P). The standard contrast step (bold) with L_{WP}=142*36 cd/m² is hard to reach.
2) 500 lux corresponds to the viewing luminance L_v=142 cd/m² for the standard offset paper (S) with the tristimulues value Y_W=88,9.
3) For the contrast C_Y =2:1 the viewing luminances of both the black in the projection and the white standard offset paper are equal (!).
Visual fatique caused by the adaptation luminance ratio 36:1 of the black at the screen and the black at the paper shall be reduced.
If for example a grey screen with the CIE tristimulus value Y_Z = 22,2 (=0,25*88.9) is used the contrast step C_{Yi} remains constant.
Then the luminance ratio of all colours at the screen and the paper has reduced to 9:1. This reduces visual fatique.

PS031−3N

Contrast steps C_{Yi} (i=1 to 8), CIE tristimulues values Y_W and Y_N according to ISO 9241−306[1)]

Contrast step C_{Yi} and Y-ratio (i=1 .. 8)	CIE tristimulus values; Ratio $Y_W : Y_N$ of White W and Black N	CIE tristimulus values; Range Y_{N1} ... Y_{N2}	Paper (S) luminance[2)]; Ratio [cd/m²] $L_{WS} : L_{NS}$	Display (E) luminance[3)]; Ratio [cd/m²] $L_{WE} : L_{NE}$	application and colour mode at work place; illuminance on display 500 lux or 250/125/62 lux
C_{Y8} **288:1**	88,9 : 0,31	0,00 ... <0,46	142 : 0,50	142 : 0,50	display, only 062 lux
C_{Y7} **144:1**	88,9 : 0,62	0,46 ... <0,93	142 : 1,00	142 : 1,00	display, only 125 lux
C_{Y6} **72:1**	88,9 : 1,25	0,93 ... <1,87	142 : 2,00	142 : 2,00	display, only 250 lux
C_{Y5} **36:1**	**88,9 : 2,50**	**1,87 ... <3,75**	**142 : 4,00**	**142 : 4,00**	**display & surface**
C_{Y4} **18:1**	88,9 : 5,00	3,75 ... <7,50	142 : 8,00	142 : 8,00	display & surface
C_{Y3} **9:1**	88,9 : 10,0	7,50 ... <15,0	142 : 16,0	142 : 16,0	display & surface
C_{Y2} **4,5:1**	88,9 : 20,0	15,0 ... <30,0	142 : 32,0	142 : 32,0	display & surface
C_{Y1} **2,2:1[4)]**	88,9 : 40,0	30,0 ... <60,0	142 : 64,0	142 : 64,0	display & surface

1) The example shows data for emissive displays (E). The standard contrast step (bold) with L_{NE}= 4 cd/m² may be reached.
2) 500 lux corresponds to the viewing luminance L_v=142 cd/m² for the standard offset paper (S) with the tristimulues value Y_W=88,9.
3) Measurement of 445 (= 500*0,889) lux corresponds to the viewing luminance L_v=142 cd/m² for an emmissive display (E).
4) For the contrast C_Y =36:1 the viewing luminances of both the black paper and the black on the screen are equal.
Also the viewing luminances of all colours at the screen and the paper are equal, for example for a 16 step grey scale.
For all black surfaces it is valid **Y_N>=2,5.** Therefore high contrast steps are only possible at the displays by reduced reflection.

PS030−7N

Contrast steps C_{Yi} (i=1 to 8), CIE tristimulues values Y_W and Y_N according to ISO 9241−306[1)]

Contrast step C_{Yi} and Y-ratio (i=1 .. 8)	CIE tristimulus values; Ratio $Y_W : Y_N$ of White W and Black N	CIE tristimulus values; Range Y_{N1} ... Y_{N2}	Display (P) illuminance; Ratio [lux] $E_{WP} : E_{NP}$	Display (P) luminance[2)]; Ratio [cd/m²] $L_{WP} : L_{NP}$	application and colour mode at work place; illuminance on display 125 lux or 62/31/15 lux
C_{Y8} **288:1**	88,9 : 0,31	0,00 ... <0,46	125*36 : 015	36*36 : 4,5	display, only 15 lux
C_{Y7} **144:1**	88,9 : 0,62	0,46 ... <0,93	125*36 : 031	36*36 : 09	display, only 31 lux
C_{Y6} **72:1**	88,9 : 1,25	0,93 ... <1,87	125*36 : 062	36*36 : 18	display, only 62 lux
C_{Y5} **36:1**	**88,9 : 2,50**	**1,87 ... <3,75**	**125*36 : 125**	**36*36 : 36**	**display & surface**
C_{Y4} **18:1**	88,9 : 5,00	3,75 ... <7,50	125*18 : 125	36*18 : 36	display & surface
C_{Y3} **9:1**	88,9 : 10,0	7,50 ... <15,0	125*09 : 125	36*09 : 36	display & surface
C_{Y2} **4,5:1**	88,9 : 20,0	15,0 ... <30,0	125*4,5 : 125	36*4,5 : 36	display & surface
C_{Y1} **2,2:1[3)]**	88,9 : 40,0	30,0 ... <60,0	125*2,25 : 125	36*2,25 : 36	display & surface

1) The example shows data for data projectors (P). The standard contrast step (bold) with L_{WP}=36*36 cd/m² is hard to reach.
2) 125 lux corresponds to the viewing luminance L_v=36 cd/m² for the standard offset paper (S) with the tristimulues value Y_W=88,9.
3) For the contrast C_Y =2:1 the viewing luminances of both the black in the projection and the white standard offset paper are equal (!).
Visual fatique caused by the adaptation luminance ratio 36:1 of the black at the screen and the black at the paper shall be reduced.
If for example a grey screen with the CIE tristimulus value Y_Z = 22,2 (=0,25*88.9) is used the contrast step C_{Yi} remains constant.
Then the luminance ratio of all colours at the screen and the paper has reduced to 9:1. This reduces visual fatique.

PS031−7N