

**Contrast steps  $C_{Y_i}$  ( $i=1$  to 8), CIE tristimulus values  $Y_W$  and  $Y_N$  according to ISO 9241-306<sup>1)</sup>**

Contrast step $C_{Y_i}$ and $Y$ -ratio ( $i=1 \dots 8$ )	CIE tristimulus values; Ratio $Y_W : Y_N$ of White $W$ and Black $N$	absolute Gamma $G_{P_k}$ ( $k=0$ to 7) for display (E) with $G_{P_0}=2,4^{2)}$ $G_{P_k}=2,4-0,18k$	Paper (S) luminance; Ratio $[cd/m^2]$ $L_{WS} : L_{NS}$	Display (E) luminance; Ratio $[cd/m^2]$ $L_{WE} : L_{NE}$	application and colour mode at work place; illuminance on display 500 lux or 250/125/62 lux
$C_{Y_8}$ <b>288:1</b>	88,9 : 0,31	$G_{P_0} = 2,40$	142 : 0,50	142 : 0,50	display, only 062 lux
$C_{Y_7}$ <b>144:1</b>	88,9 : 0,62	$G_{P_1} = 2,22$	142 : 1,00	142 : 1,00	display, only 125 lux
$C_{Y_6}$ <b>72:1</b>	88,9 : 1,25	$G_{P_2} = 2,04$	142 : 2,00	142 : 2,00	display, only 250 lux
$C_{Y_5}$ <b>36:1<sup>3)</sup></b>	<b>88,9 : 2,50</b>	$G_{P_3} = 1,86$	<b>142 : 4,00</b>	<b>142 : 4,00</b>	<b>display &amp; surface</b>
$C_{Y_4}$ <b>18:1</b>	88,9 : 5,00	$G_{P_4} = 1,68$	142 : 8,00	142 : 8,00	display & surface
$C_{Y_3}$ <b>9:1</b>	88,9 : 10,0	$G_{P_5} = 1,50$	142 : 16,0	142 : 16,0	display & surface
$C_{Y_2}$ <b>4,5:1</b>	88,9 : 20,0	$G_{P_6} = 1,32$	142 : 32,0	142 : 32,0	display & surface
$C_{Y_1}$ <b>2,25:1</b>	88,9 : 40,0	$G_{P_7} = 1,14$	142 : 64,0	142 : 64,0	display & surface

1) The example is intended for emissive displays (E). The standard contrast step (bold)  $C_{Y_5}$  with  $L_{NE} = 4 \text{ cd/m}^2$  may be reached.

2) The computer operating system *Apple* has used the value 1,8 until 2010. The change to 2,4 (= *Windows*) is in the wrong direction.

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 fatigue based on an adaptation change between paper and display is excluded.

For all black surfaces it is valid  $Y_N > 2,5$ . Therefore high contrast steps are only possible at the displays by reduced reflection.