

# Contrast steps $C_{Yi}$ ( $i=1$ to 8), and absolute and relative Gamma according to ISO 9241-306<sup>1)</sup>

| Contrast step $C_{Yi}$ and Y-ratio ( $i=1 \dots 8$ ) | CIE tristimulus values; Ratio $Y_W : Y_N$ of White $W$ and Black $N$ | CIE tristimulus values; Range $Y_{N1} \dots Y_{N2}$ | absolute Gamma $G_{Pk}$ ( $k=-3$ to 4) for display (P) with $G_{p0}=1,86^{2)}$ $G_{Pk}=1,86-0,18k$ | relative Gamma $g_{Pk}$ ( $k=-3$ to 4) for display (P) with $G_{p0}=1,86^{2)}$ $g_{Pk}=G_{Pk}/1,86$ | 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                                      | $G_{p,-3} = 2,40$                                                                                  | $g_{p,-3} = 1,29$                                                                                   | display, only 062 lux                                                                       |
| $C_{Y7}$ 144:1                                       | 88,9 : 0,62                                                          | 0,46 ... <0,93                                      | $G_{p,-2} = 2,22$                                                                                  | $g_{p,-2} = 1,20$                                                                                   | display, only 125 lux                                                                       |
| $C_{Y6}$ 72:1                                        | 88,9 : 1,25                                                          | 0,93 ... <1,87                                      | $G_{p,-1} = 2,04$                                                                                  | $g_{p,-1} = 1,10$                                                                                   | display, only 250 lux                                                                       |
| $C_{Y5}$ 36:1                                        | 88,9 : 2,50                                                          | 1,87 ... <3,75                                      | $G_{p0} = 1,86$                                                                                    | $g_{p0} = 1,00$                                                                                     | display & surface                                                                           |
| $C_{Y4}$ 18:1                                        | 88,9 : 5,00                                                          | 3,75 ... <7,50                                      | $G_{p1} = 1,68$                                                                                    | $g_{p1} = 0,90$                                                                                     | display & surface                                                                           |
| $C_{Y3}$ 9:1                                         | 88,9 : 10,0                                                          | 7,50 ... <15,0                                      | $G_{p2} = 1,50$                                                                                    | $g_{p2} = 0,81$                                                                                     | display & surface                                                                           |
| $C_{Y2}$ 4,5:1                                       | 88,9 : 20,0                                                          | 15,0 ... <30,0                                      | $G_{p3} = 1,32$                                                                                    | $g_{p3} = 0,71$                                                                                     | display & surface                                                                           |
| $C_{Y1}$ 2,25:1 <sup>3)</sup>                        | 88,9 : 40,0                                                          | 30,0 ... <60,0                                      | $G_{p4} = 1,14$                                                                                    | $g_{p4} = 0,61$                                                                                     | display & surface                                                                           |

- 1) The example is intended for data projectors (P) with  $G_{p0}=1,86$ . Compare NTSC television:  $G_{p0}=1,8$ .
- 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  $C_Y=2:1$  the viewing luminances of both the black in the projection and the white standard offset paper are equal (!). Visual fatigue 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  $Y_Z = 22,2$  ( $=0,25 \cdot 88,9$ ) 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 fatigue.