

# Contrast step $C_{Yi}$ ( $i=1$ to 8), CIE tristimulus value $Y_N$ , grey steps according to ISO 9241-306<sup>1)</sup>

| Contrast step $C_{Yi}$ and $Y$ -ratio ( $i=1 \dots 8$ ) | CIE tristimulus value $Y_N$ and CIE lightness $L_N^*$ of black | total viewing display illuminance $E_{P+R}$ [lux] <sup>2)</sup> | measured projector (P) display illuminance $E_P$ [lux] <sup>2)</sup> | room light (R) display illuminance $E_R$ [lux] <sup>2)</sup> | grey steps without output linearisation delta $L^*=1$ amount $a_n$ <sup>3)</sup> | grey steps with output linearisation delta $L^*=1$ amount $a_1$ <sup>3)</sup> |
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The following example assumes that a projector produces the contrast step  $C_{Y3}$  for the illuminances measured for 5 times the horizontal A4 direction (149 cm):

|                       |         |           |      |     |    |    |
|-----------------------|---------|-----------|------|-----|----|----|
| $C_{Y4}$ <b>36:1</b>  | 10 / 38 | 2400+2000 | 4275 | 125 | 38 | 77 |
| $C_{Y3}$ <b>9:1</b>   | 20 / 52 | 1200+1000 | 2075 | 125 | 34 | 68 |
| $C_{Y2}$ <b>4,5:1</b> | 40 / 70 | 600+500   | 975  | 125 | 28 | 57 |

The illuminances  $E_P$  are by the factor 4 less for 10 times the A4-direction (298 cm):

|                                   |         |          |      |     |  |    |
|-----------------------------------|---------|----------|------|-----|--|----|
| $C_{Yx1}$ <b>4:1<sup>4)</sup></b> | 30 / 61 | 1069+125 | 1069 | 125 |  | 34 |
| $C_{Yx2}$ <b>2:1<sup>5)</sup></b> | 45 / 74 | 518+125  | 518  | 125 |  | 21 |

- 1) The example is intended for data projectors (P). The standard contrast step (bold)  $C_{Y5} = 36:1$  is not reached.
- 2) 125 lux corresponds to the viewing luminance  $L_v = 35 \text{ cd/m}^2$  for a standard white paper with the tristimulus value  $Y_w = 88,9$ .
- 3) For the amount of discriminable colour steps use the equations:  $c_n = a_n^3$  or  $c_1 = a_1^3$ , for example  $c_n = 4096$  for  $a_n = 16$ .
- 4) The viewing contrast  $C_{Yx1} = 1194:125 = 8,5:1$  is larger compared to the contrast  $C_{Y2} = 4,5:1$ . The contrast step is  $C_{Y2} = 4,5:1$ .
- 5) The viewing contrast  $C_{Yx2} = 643:125 = 5,1:1$  is larger compared to the contrast  $C_{Y2} = 4,5:1$ . The contrast step is  $C_{Y2} = 4,5:1$ .