## *Weber-Fechner* law in CIE 230:2019 for threshold colour differences of surface colours

The *Weber-Fechner* law describes the lightness $L^*_r$ as ***logarithmic*** function of $L_r$.
The *Stevens* law describes the lightness $L^*_{CIELAB}$ as ***potential*** function of $L_r=Y/5$.
IEC 61966-2-1 uses a similar potential function $L^*_{IEC} = m\, L_r^{1/2,4}$.
The *Weber-Fechner* law is equivalent to the equation: $\Delta L_r = c\, L_r$ [1]
*Integration* leads to the logarithmic equation: $L^*_r = k \log(L_r)$. [2]
*Derivation* leads for $\Delta L^*_r=1$ to the linear equation: $L_r/\Delta L_r = k = 57$. [3]
For ***Adjacent*** colours in offices the standard contrast range is **25:1**=90:3,6.

**Table 1: CIE tristimulus value *Y*, luminance *L*, and lightnesses *L****

| **Colour (matte)** | **Tritimulus value** | **office luminance** | **relative luminance** | **CIE lightness** | **relative lightness** |
|---|---|---|---|---|---|
| ***(contrast)* (25:1=90:3,6)** | ***Y*** | ***L* [cd/m²]** | $L_r = L/L_Z$ | $L^*_{CIELAB} \sim m\, L_r^{1/2,4}$ | $L^*_r = k \log(L_r)$ |
| White W (paper) | 90 =18*5 | 142 =28,2*5 | 5 | 94 =50+44 | 40 =*k* log(5) |
| Grey Z (paper) | 18 | 28,2 | 1 | 50 | 0 =*k* log(1) |
| Black N (paper) | 3,6 =18/5 | 5,6 28,2/5 | 0,2 | 18 50−32 | −40 =*k* log(0,2) |

For the lightness range between $L^*_r=-40$ and 40 the constant is: $k=40/\log(5)=57$