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 for $\Delta L^*_r = 1$ leads to the linear equation: $L_r/\Delta L_r = k = 57$. [3]
For 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]**	$L_r = L/L_u$	$L^*_{CIELAB} \sim m\, L_r^{1/2,4}$	$L^*_r = k \log(L_r)$
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: $k = 40/\log(5) = 57$