Weber-Fechner law in CIE 230:2019 for threshold colour differences of surface colours; relations between tristimulus value, lightness and luminance

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 lightness *L**

Colour (matte)	**Tritimulus value**	**office luminance**	**relative luminance**	**CIELAB lightness**	**TUBJND lightness**
***(contrast)* (25:1=90:3,6)**	***Y***	***L*** **[cd/m²]**	$L_r = L/L_u$	$L^*_{CIELAB} \sim m\, L_r^{1/2,4}$	$L^*_{TUBJND} = k \log(L_r)$
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 =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: $k=40/\log(5)=57$