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 ΔL^*_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

fem41−1A

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The *Weber-Fechner* law describes the lightness L^*_r as ***logarithmic*** function of L_r.
For local adaptation to ***Adjacent*** colours there is a ***visible contrast*** **100:1.**
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 $L^*_{IEC} = m\, L_r^{1/2,4}$.
For ***separate*** colours on a grey surround there is a ***visible contrast*** **25:1**=90:3,6.
see K. Richter, 2006, Relation of *Weber* and *Stevens* law at achromatic threshold.
http://farbe.tu-berlin.de/A/BAMAT.PDF

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fem41−2A

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fem41−3A

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For ***separate*** colours on a grey surround there is a ***visible contrast*** **25:1**=90:3,6.
Surface colours cover the ***visible contrast 100:1.*** Negative film covers the ***contrast 100000:1*** (density 5:1). Film stores images from under to over exposure

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

fem41−4A

fem41−3n