Decibel (symbol: dB) is a unit to describe the ratio between two power levels. The term is composed of the two parts "deci", meaning "one tenth" and "Bel" meaning $\log_{10}(P/P_{\text{ref}})$, i.e., the logarithm with base 10 to the ratio between the power P and a reference power P_{ref}. The decibel thus becomes $10 \times \log_{10}(P/P_{\text{ref}})$. However, when comparing amplitudes (e.g., sound pressures or voltages), one has to use $20 \times \log_{10}(A/A_{\text{ref}})$ because the power is a function of amplitudes squared, and $20 \times \log_{10}(A/A_{\text{ref}}) = 10 \times \log_{10}(A^2/A^2_{\text{ref}})$. When comparing impedances or mobilities the expression $10 \times \log_{10}(x/x_{\text{ref}})$ should be used, because they are *not* squared in the power expression. Table gives a list of ratios derived from dB values.

Table 1: Conversion from dB to ratio

Power [dB]	Amplitude [dB]	Ratio (rounded)
+30	+60	1000
+20	+40	100
+10	+20	10
+5	+10	3.16
+3	+6	2
+1.5	+3	1.41 (= √2)
+1	+2	1.26
+0.5	+1.0	1.12
+0.25	+0.5	1.06
0	0	1
–0.25	–0.5	0.94
–0.5	–1.0	0.89
–1	–2	0.79
–1.5	–3	0.71 (= 1/√2)
–3	–6	1/2
–5	–10	0.32
–10	–20	1/10
–20	–40	1/100
–30	–60	1/1000

Notice: You cannot use Table 1 for converting from "power dB" to "amplitude dB", because when amplitudes ratios are squared, as they are in power calculations, both power and amplitude^2 ratios end up with the same dB value.

Because dB is a logarithmic term, adding decibels is equivalent to multiplying their corresponding ratios: e.g., 21 amplitude decibels is equal to the ratio 10 × 1.12 = 11.2. Otherwise, calculation of ratio from power- and amplitude decibels is $10^{\text{dB}/10}$ and $10^{\text{dB}/20}$, respectively.

dB-SPL (Sound Pressure Level) is an expression for absolute sound-pressure levels, using the just barely audible sound-pressure level at 1000 Hz as the zero-dB reference:

Sound pressure (RMS) $= 0.0002\ \mu\text{Bar}$ (barometric pressure)
$= 20\ \mu\text{Pa}$ (micro Pascals).

(RMS signifies “Root Mean Square”, i.e., the effective sound pressure.)

We thus get the following SPL levels:

Sound	**dB-SPL**
Jet engine at 3m	140
Threshold of pain	130
Rock concert	120
Accelerating motorcycle at 5m	110
Pneumatic hammer at 2m	100
Noisy factory	90
Vacuum cleaner	80
Busy traffic	70
Quiet restaurant	50
Residential area at night	40
Empty movie house	30
Rustling of leaves	20
Human breathing (at 3m)	10
Threshold of hearing (good ears)	0

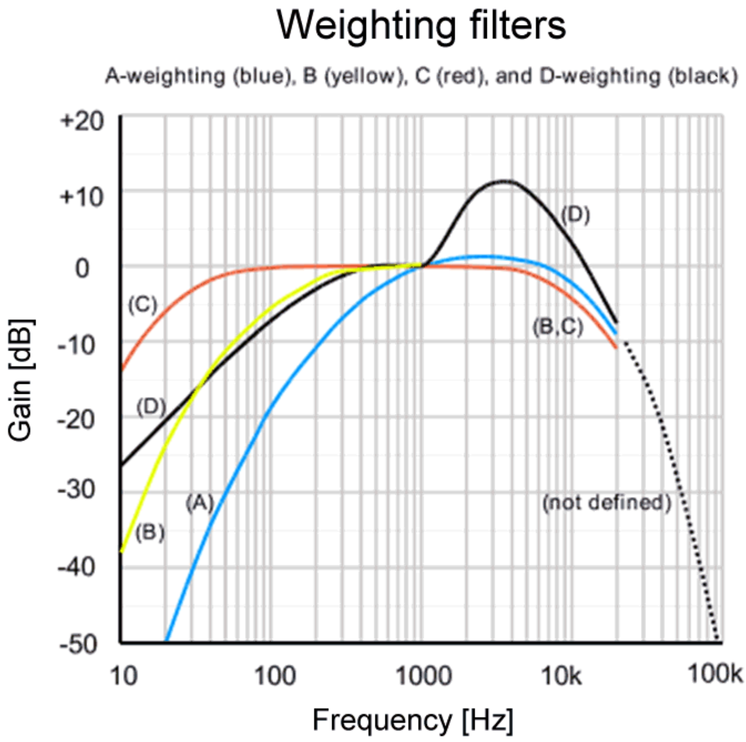
Table 2: Approximate dB-SPL level of common sounds. (Information from S. S. Stevens, F. Warshofsky, and the Editors of Time-Life Books, *Sound and Hearing*, Life Science Library, Time-Life Books, Alexandria, VA, 1965, p. 173.)

In terms of acceptable exposure to the different sound levels, the rule of thumb reads:

At 100 dB-SPL, maximum safe exposure per day is ca 15 minutes.

For every energy doubling (halving), i.e., +3 dB (–3 dB),
the permitted exposure time should be halved (doubled).

Sometimes you will encounter the terms **dB(A)**, **dB(B)**, **dB(C),** and **dB(D**), where (A), (B), (C), and (D) stands for different filters used to compensate for the subjective loudness levels (sensitivity) of the average ear, when presenting objectively measured intensity curves in the frequency domain (see the figure below). Notice that all curves roll off in the bass because the ear is progressively less sensitive for these frequencies. The intention of weighting is to present every frequency with the relative loudness we experience in real-life situations.



The rationale behind having different weighting curves is that the relative sensitivity of the ear varies with sound intensity as well as with signal characteristics. E.g., dB(A) is best suited for low-level sounds (like noise in audio amplifiers, etc), while dB(C) is best suited for high-level sounds.