8.2 Decibel A, B and C

Sound pressure is not equally sensed by human ear at different frequencies - compensated with dB(A), dB(B) or dB(C) filters.

The human ear is more sensitive to sound in the frequency range 1 kHz to 4 kHz than to sound at very low or high frequencies. Higher sound pressures are therefore acceptable at lower and higher frequencies than in the mid range.

The knowledge about human ear is important in acoustic design and sound measurement. To compensate, sound meters are normally fitted with filters adapting the measured sound response to the human sense of sound.

Common filters are

- *dB(A)*
- *dB(B)*
- *dB(C)*

dB(A)

The decibel A filter is widely used. **dB(A)** roughly corresponds to the inverse of the **40 dB** (at 1 kHz) equal-loudness curve for the human ear.

Using the dB(A)-filter, the sound level meter is less sensitive to very high and very low frequencies. Measurements made with this scale are expressed as dB(A).

dB(B) and dB(C)

The decibel C filter is practically linear over several octaves and is suitable for subjective measurements at very high sound pressure levels. The decibel B filter is between C and A. The B and C filters are seldom used.

Comparing dB(A), dB(B) and dB(C)

The decibel filters A, B and C are compared below:

Relative Response (dB)	Frequency (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
dB(A)	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1
dB(B)	-17	-9	-4	-1	0	0	0	-1	-3
dB(C)	-3	-0.8	-0.2	0	0	0	-0.2	-0.8	-3

Table 8.2.-1: Comparing dB(A), dB(B) and dB(C)

Sound Pressure (SP)

The Sound Pressure is the force **(N)** of sound on a surface area **(m^2)** perpendicular to the direction of the sound. The SI-units for the Sound Pressure are **N/m^2 or Pa**.

The Sound Pressure Level (SPL)

The lowest sound pressure possible to hear is approximately

$2 \cdot 10^{-5}$ Pa (20 micro Pascal, 0.02 mPa), 2 ten billionths of a an atmosphere.

It therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human hear able sound - *$2\ 10^{-5}$ Pa, 0 dB*.

The Sound Pressure Level:

$$L_p = 10 \cdot \log\left(\frac{p^2}{p_{ref}^{\ 2}}\right) = 10 \cdot \log\left(\frac{p}{p_{ref}}\right)^2 = 20 \cdot \log\left(\frac{p}{p_{ref}}\right)$$

where

L_p = sound pressure level (dB)

p = sound pressure (Pa)

p_{ref} = $2 \cdot 10^{-5}$ - reference sound pressure (Pa)