Sound Intensity Level

Sound intensity is defined as the rate of energy flow (sound power) across a unit area. The basic units are watts/m^2.

The dynamic range of human hearing and sound intensity spans from 10^{-12} Watt/m^2 to 10^{-100} Watt/m2. This span makes the absolute value of the sound intensity impractical for normal use.

As we are normally more interested in comparing intensities rather than dealing with absolute values, we use the value of sound intensity = 10^{-12} Watt/m^2 , the lowest human hearable sound, as reference level.

We can refer to SL sound intensity level within two different units: bel and dB (the tenth part of a bel). If one sound has an intensity I0 (in Watt/m^2) and a second sound has an intensity I_1, the second has an intensity relative to the first of I_1/I_0. The log of this ratio gives us a value for the relationship, the unit being the bel:

SL= log10(I_1/I_0) Bel

However, this relationship in dB is more used nowadays, and can be expressed this way:

SL= 10log10(I_1/I_0) dB,

where SL is the sound intensity level, I_1 is the intensity and I_0 is the standard reference sound intensity (10^{-12} Watt/m^2).

The logarithmic sound intensity level scale match the human sense of hearing. Doubling the intensity increases the sound level by 3 dB (10 log (2))

References:

http://en.wikipedia.org/wiki/Sound_intensity

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http://personal.cityu.edu.hk/~bsapplec/sound2.htm