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Decibels & Loudness – What Does it Mean?

The **decibel** (**dB**) is a logarithmic unit of measurement that expresses the magnitude of a physical quantity (usually power or intensity) relative to a specified or implied *reference level*. Since it expresses a ratio of two quantities with the same unit, it is a dimensionless unit. A decibel is one tenth of a **bel**, a seldom-used unit.

The term decibel is most widely known as a measure of sound pressure level,

Loudness is the quality of a sound that is the primary psychological correlate of physical strength (amplitude).

Loudness, a subjective measure, is often confused with objective measures of sound pressure such as decibels or sound intensity. Filters such as A-weighting attempt to adjust sound measurements to correspond to loudness as perceived by the average human. However, as the perception of loudness varies from person to person it cannot be universally measured using any single metric.

Sound level, loudness, and sound pressure are not the same things; indeed there is not even a simple relationship between them, because the human hearing system is more sensitive to some frequencies than others, and furthermore, its frequency response varies with level, as has been demonstrated by the measurement of equal-loudness contours. In general, low frequency and high frequency sounds are perceived to be not as loud as mid-frequency sounds, and the effect is more pronounced at low pressure levels, with a flattening of response at high levels. Sound pressure level meters (SPL meters) therefore incorporate weighting filters, which reduce the contribution of low and high frequencies to produce a reading that corresponds approximately to what we hear. Loudness however requires the use of a loudness meter as described by Zwicker and others.

Research in the 1960s demonstrated that determinations of equal-loudness made using pure tones are not directly relevant to our perception of noise. This is because the cochlea in our inner ear analyses sounds in terms of spectral content, each 'hair-cell' responding to a narrow band of frequencies known as a critical band. The high-frequency bands are wider in absolute terms than the low frequency bands, and therefore 'collect' proportionately more power from a noise source. However, when more than one critical band is stimulated, the outputs of the various bands are summed by the brain to produce an impression of loudness. For these reasons equal-loudness curves derived using noise bands show an upwards tilt above 1 kHz and a downward tilt below 1 kHz when compared to the curves derived using pure tones. The additional difficulty in measuring the impact of loudness in terms of dBs is the virtual unlimited variances in sensitivities in the way that individual the human brain perceives loudness.