Lexicon of Noise Parameters and Terminology

A wide range of parameters are used to assess human reaction to noise. The highly variable response of individuals to noise and the many characteristics (level, frequency content, impulsiveness, intermittency, etc.) of different types of noise sources has led to many attempts to provide single-number ratings of the effect of that noise. The following list summarizes most of the parameters in common usage.

"A" frequency weighting: The method of frequency weighting the electrical signal within a noise-measuring instrument is to simulate the way the human ear responds to a range of acoustic frequencies. It is based on the 40 dB equal loudness curve. The symbols for the noise parameters often include the letter "A" (e.g., L_{Aeq}) to indicate that frequency weighting has been included in the measurement.

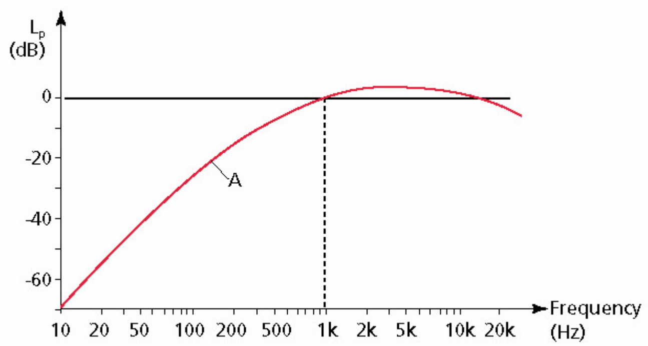


Fig. 1

Fast, Slow and Impulse time weightings: Standardized response times were originally built into noise measuring instruments to provide visual indication of fluctuating noise levels. Environmental assessment standards usually specify which time weighting (F, S or I) to use.

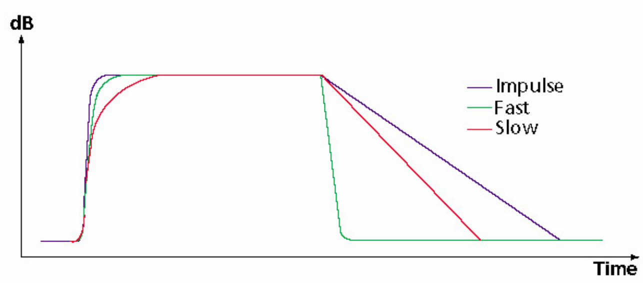


Fig. 2

$L_{Aeq,T}$: A widely used noise parameter that calculates a constant level of noise with the same energy content as the varying acoustic noise signal being measured. The letter "A" denotes that the A-weighting has been included and "eq" indicates that an equivalent level has been calculated. Hence, L_{Aeq} is the A-weighted-equivalent continuous noise level.

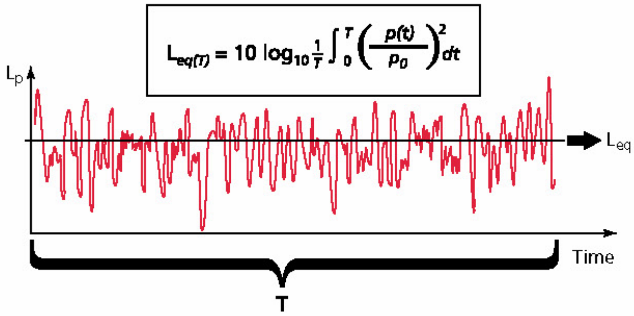


Fig. 3

L_{AE}: Sound Exposure Level (SEL): A parameter closely related to L_{Aeq} for assessment of events (aircraft, trains, etc.) that have similar characteristics but are of different duration. The L_{AE} value contains the same amount of acoustic energy over a "normalized" one second period as the actual noise event under consideration.

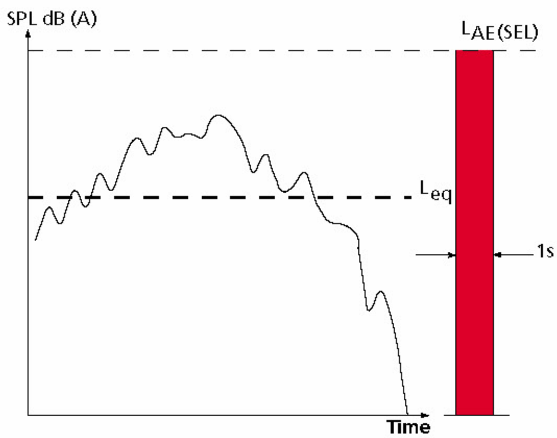


Fig. 4

L_{AFMax}, L_{ASMax} or L_{AIMax}: Maximum A-weighted noise level measured with Fast (F), Slow (S) or Impulse (I) time weighting. They are the highest level of environmental noise occurring during the measurement time. They are often used in conjunction with another noise parameter (e.g., L_{Aeq}) to ensure a single noise event does not exceed a limit. It is essential to specify the time weighting (F, S or I).

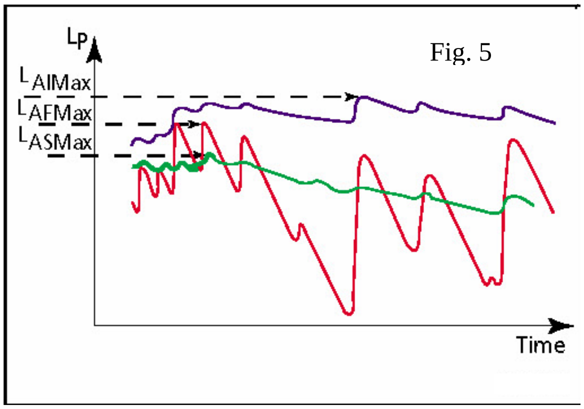


Fig. 5

L_{AFMin}, L_{ASMin} or L_{AIMin}: Minimum A-weighted noise level measured with Fast (F), Slow (S) or Impulse (I) time weighting. They are the lowest level of environmental noise occurring during the measurement time.

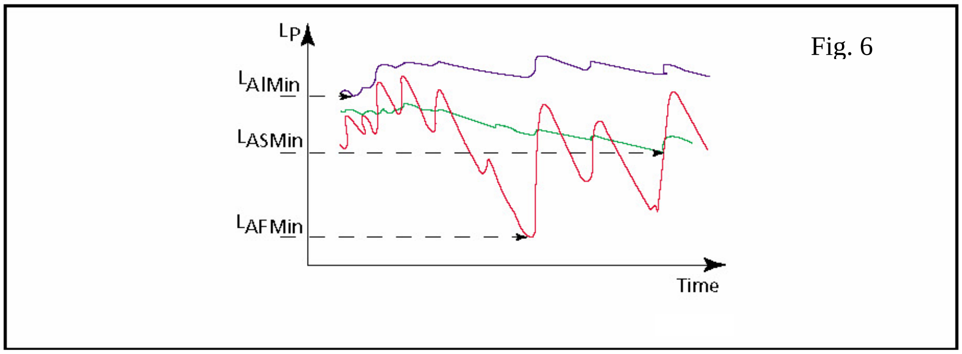


Fig. 6

$L_{AFN,T}$ Percentile levels: The level of A-weighted noise exceeded for N% of the measurement time. In some countries the $L_{AF90,T}$ (level of noise exceeded for 90% of the measurement time) or $L_{AF95,T}$ level is used as a measure of the background noise level. Note that the time weighting (usually Fast) should be stated.

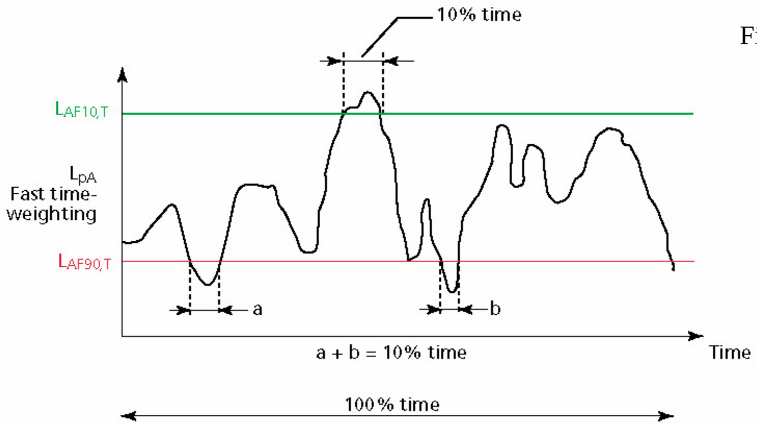


Fig. 7

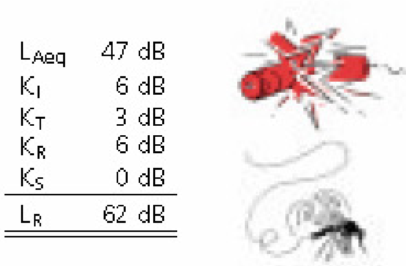
$L_{Ar,Tr}$ Rating level: The A-weighted equivalent continuous noise level ($L_{Aeq,T}$) during a specified time period with specified adjustments for tonal, impulsive or intermittent noise. In general, the rating level is given by:

$$L_{\mathrm{Ar,Tr}} = L_{\mathrm{Aeq,T}} + K_{\mathrm{I}} + K_{\mathrm{T}} + K_{\mathrm{R}} + K_{\mathrm{S}}$$

In some countries, a subjective assessment of the characteristics of the noise in question is made. In other countries, an objective test is made to see whether the noise is tonal or impulsive.

For example (1) a 1/3-octave frequency band of noise which exceeds the levels in adjacent bands by 5 dB or more for the detection of tonal noise and, (2) a measurement of the difference between an Impulse and A-weighted "L_{eq}" parameter ($L_{AIm,T}$) and $L_{Aeq,T}$ would reveal the presence of impulses.

Fig. 8



Aircraft Noise Parameters: If aircraft noise is assessed as just a normal noise source (as is usually the case), then the usual environmental noise parameters required are L_{ASMax} and L_{AE} (equivalent to L_{AX} in some older standards) for single events and $L_{Aeq,T}$ for a succession of noise events. In some cases (e.g., aircraft certification), more detailed analysis of the 1/3-octave spectral content of the aircraft noise is made at 0.5 second intervals. Perceived noise level (L_{PN}) is then calculated by converting the sound pressure levels to perceived noisiness values according to the ICAO Annex 16 standards.

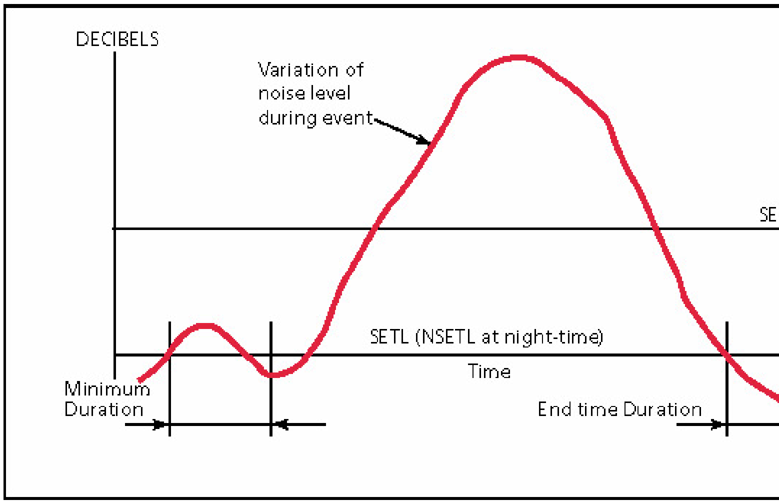


Fig. 9

If the aircraft noise spectrum has pronounced tonal content, then an additional correction of up to 6.7 dB is added to the perceived noise level (L_{PN}) to give a tone-corrected perceived noise level L_{TPN}. The total subjective effect of an air-craft's flyover must take into account the time history of the flight. This is accounted for by integrating the tone-corrected, perceived noise level to produce the effective perceived noise level, L_{EPN}. Full details can be found in the ISO 3891 standard.

L_{DN}: Day-night average sound level. An L_{Aeq} with 10 dB(A) penalty for environmental noise occurring from 22:00 to 07:00 to take account of the increased annoyance at night.

Frequency spectrum: In environmental noise investigations, it is often found that the single-number indices, such as L_{Aeq}, do not fully represent the characteristics of the noise. If the source generates noise with distinct frequency components (tonal noise), then it is useful to measure the frequency content in octave, 1/3-octave or narrower (Fast Fourier Transform) frequency bands. For calculating noise levels (prediction), octave spectra are often used to account for the frequency characteristics of sources and propagation.

Sound power is the acoustic power (W) radiated from a sound source. This power is essentially independent of the surroundings, while the sound pressure depends on the surroundings (reflecting surfaces) and distance to the receiver. If the sound power is known, the sound pressure at a point can usually be calculated, while the reverse is true only in special cases (e.g., in an anechoic or reverberation room). So, the sound power is very useful to characterize noise sources and to calculate sound pressure. Like sound pressure, sound power is measured in logarithmic units, the 0 dB sound power level corresponding to 1 pW (picowatt = 10^{-12} W). The symbol used for sound power level is L_W, and it is often specified in dB(A), 1/1 octaves or 1/3 octaves.

Fig. 10