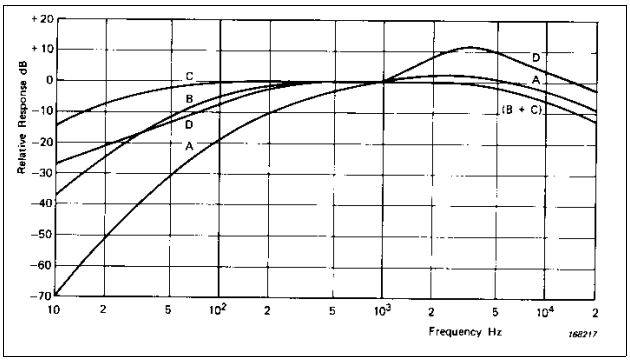

Fig 14 Weighting scales

Many sounds vary in level and there are several indexes used for measuring these varying sounds. Most commonly the equivalent continuous sound pressure level is used, L_{eq}. If measured on the 'A' scale it is known as L_{Aeq}.

It is based on the principle of the average energy in the sound over the measurement period in question. Sometimes the measurement period is included as well, $L_{aeq,T}$, where T is the measurement period.

The sound exposure level, SEL or LAE or LAX, is the level which, if maintained for one second, would deliver the same A-weighted sound energy as a given noise event. An example of its use would be in measurement of rail noise. Rail noise is often measured as the L_{Aeq} over a 24 hour period. Let us assume the same type of train passed at certain intervals over a given day, making similar amounts of noise. By measuring the SEL of one train, performed by direct measurement or by SEL = $L_{Aeq,T}$ + 10 log T, the $L_{Aeq,24h}$ could be calculated with a knowledge of the number of trains in the 24 hour period,

$L_{Aeq,24h}$ = SEL + 10 logN - 10 Log (60 x 60 x 24)
where N is the number of trains.

In the U.K. the LAeq,16h is now generally used for aircraft noise, assuming no flights or severe restrictions at night.

While the LAeq is increasingly used for measurements of all types of noise, early research in the U.K. showed that of simple statistical noise measurements the L_{A10} was the best correlated with annoyance from traffic noise. The L_{A10} is the A-weighted sound pressure level exceeded for 10% of the time. Background noise level is often described by the L_{A90}.

European Health and Safety regulations restrict noise exposure by use of an 8 hour L_{Aeq}, requiring action to be taken if $L_{Aeq,8h}$ exceeds 85 dB and further action if it exceeds 90 dB.

While L_{A90} is often used for environmental background noise level, for internal spaces LAeq or Noise Rating/Criteria curves are used. The British Standard Code of Practice

for Sound Insulation and Noise Reduction in Buildings (BS 8233:1987) uses L_{Aeq} to describe maximum/optimum background levels in internal spaces. For instance for cellular offices L_{Aeq} = 40 - 45 dB is recommended while for open plan offices L_{Aeq} = 45 - 50 dB is recommended. Note that these are optimum levels. With the limited sound insulation from office partitions a reduction in the background noise level in cellular offices can lead to a loss of acoustic privacy and with the open plan offices the background noise level (or masking noise) actually provides the acoustic privacy. Consideration must also be given to the background noise itself. Road traffic noise is variable and the frequency spectrum itself is not ideal for masking speech. Mechanical service noise is better but certain air conditioning systems such as VAV have variable noise levels, being much quieter under low load conditions. In some circumstances with open plan offices an electronically created noise (often white noise) is introduced into the office to provide masking.

Noise Rating and Noise Criteria curves (and their derivatives) were developed mainly to specify building services noise, the former being a European development and the latter a development form the USA Although they can be used in conjunction with L_{eq}'s or L_{10}'s to specify varying noises they are basically devised for steady sounds and the curves generated from octave band noise levels. To satisfy a particular Noise Rating/Criteria the level in any of the octave bands should not exceed that specified by the particular curve. An approximate relation is LAeq = NR + 8 but will vary according to noise spectrum of source.

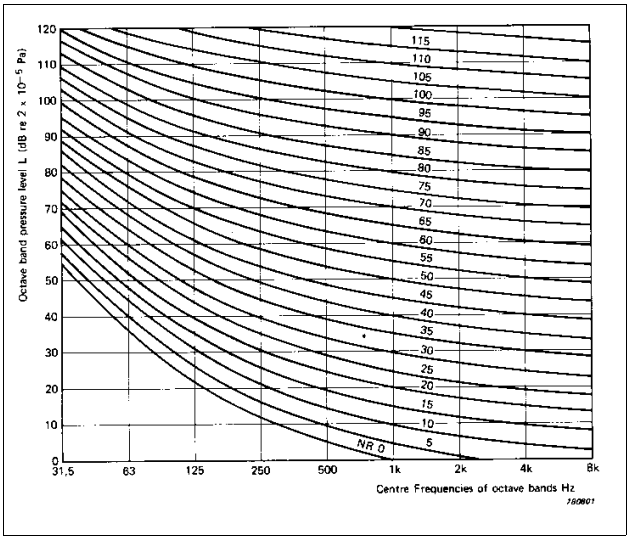

Fig 15 Noise rating curves

In the example of the offices above, the sound as heard by a cellular office occupant (their acoustic privacy) can be described by the the sum of the mean sound insulation { expressed as the SRI(sound reduction index-see section on sound insulation)} and the ambient noise level in dBA (= L_{Aeq} if noise steady) or NR(ref 11)

Sound as heard by Occupant	Mean SRI + L_{Aeq}	Mean SRI + NR