Glossary of Terms

CRITERION LEVEL:

The criterion level is the maximum allowable exposure to accumulated noise; it gives the conditions that result in 100% dose. The criterion level is typically set by a regulating agency such as OSHA and is usually not applicable for community noise monitoring.

Example: OSHA mandates the criterion level (maximum allowable accumulated noise exposure) to be 90dB for 8 hours. For an 8 hour sample, an average level (LAVG) of 90dB will result in 100% dose.

For the OSHA HEARING CONSERVATION AMENDMENT, the “action level” is 85dB for 8 hours. This would result in a 50% dose reading. Note that the criterion level has not changed. [If the criterion level is changed to 85dB then an 8 hour average of 85dB would result in 100% dose.]

DOSE:

Related to the criterion level, a dose reading of 100% is the maximum allowable exposure to accumulated noise. For OSHA, 100% dose occurs for an average sound level of 90dB over an 8 hour period (or any equivalent exposure). By using a TWA reading rather than the average sound level, the time period is no longer explicitly needed. A TWA of 90dB is the equivalent of 100% dose. The dose will double (halve) every time the TWA increases (decreases) by the exchange rate.

Example: OSHA uses an exchange rate of 5dB. Suppose the TWA is 100dB. The dose would double for each 5dB increase over the criterion level of 90dB. The resulting dose is therefore 400%. If the TWA was instead equal to 80dB then the dose would halve for each 5dB below the criterion level. The resulting dose would be 25%.

When taking noise samples less that the full workday, dose is an easy number to work with because it is linear with respect to time.

*Example: If a 0.5 hour sample results in 9% dose and the workday is 7.5 hours long, then the dose for the full workday would be computed as (7.5 hours / 0.5 hours) * 9% = 135% dose. This is computed making the assumption that the sampled noise will continue at the same levels for the full 7.5 hour workday*.

EXCEEDANCE LEVELS:

Exceedance levels represent the percent of the run time that was spent at or above the corresponding dB level.

Example: An L40 equal to 73dB would mean that for 40% of the run time, the decibel level was equal to or higher than 73dB.

EXCHANGE RATE (DOUBLING RATE):

Exchange rate refers to how the sound energy is averaged over time. Using the decibel scale, every time the sound energy doubles, the measured level increases by 3dB. This is the 3dB exchange rate that most of the world uses. For every increase of 3dB in the time weighted average, the measured DOSE would double.

Some organizations such as OSHA in the U.S. have argued that the human ear self compensates for changing noise levels and they felt that the 3dB exchange rate should be changed to more closely match the response of the human ear. OSHA currently uses a 5dB exchange rate which would mean that the reported DOSE would double with every 5dB increase in the time weighted average. The exchange rate affects the integrated reading LAVG, DOSE, and TWA but does not affect the instantaneous sound level.

LAVG:

LAVG is simply the average sound level measured over the run time. This becomes a bit confusing when thresholds are used. Any sound below the threshold is not included in this average. Remember that sound is measured in the logarithmic scale of decibels therefore the average can not be computed by simply adding the levels and dividing by the number of samples. When averaging decibels, short durations of high levels can significantly contribute to the average level.

Example: Assume the threshold is set to 80dB and the exchange rate is 5dB (the settings of OSHA's Hearing Conservation Amendment). Consider taking a one hour noise measurement in an office where the A-weighted sound level was typically between 50dB and 70dB. If the sound level never exceeded the 80dB threshold during the one hour period, then the LAVG would not indicate any reading at all. If 80dB was exceeded for only a few seconds due to a telephone ringing near the instrument, then only those seconds will contribute to the LAVG resulting in a level perhaps around 40dB (notably lower than the actual levels in the environment).

LDN (Day/Night Sound Level):

This measurement is a 24 hour average sound level where 10dB is added to all of the readings that occur between 10pm and 7am. This is primarily used in community noise regulations where there is a 10dB "penalty" for night time noise. Typically LDN's are measured using A weighting, a 3dB exchange rate, and no threshold.

LEQ:

The true equivalent sound level measured over the run time. The term LEQ is functionally the same as LAVG except that it is only used when the exchange rate is set to 3dB and the threshold is set to none.

MAX LEVEL:

The maximum level is the highest sampled sound level during the instrument's run time allowing for the RESPONSE that the unit is set for (fast or slow).

PEAK LEVEL:

Peak is the highest instantaneous sound level that the microphone detects. Unlike the MAX LEVEL, the peak is detected independently of the slow of fast RESPONSE that the unit is set for.

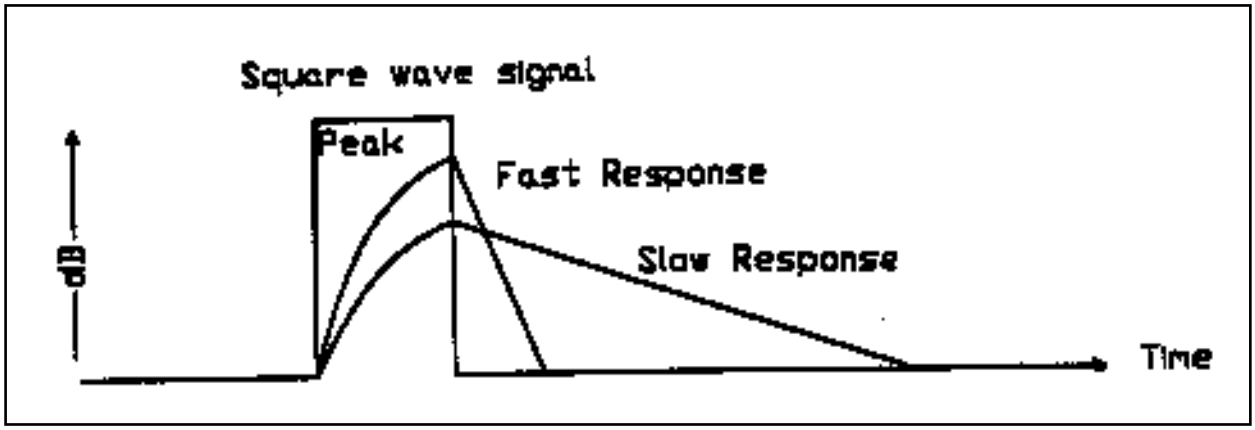
Example: The peak circuitry is very sensitive. Test this by simply blowing across the microphone. You will notice that the peak reading may be 120dB or greater. When taking a long term noise sample (such as a typical 8 hour workday sample for Osha compliance), the peak level is often very high. Because brushing the microphone over a shirt collar or accidentally bumping it can cause such a high reading, the user must be careful of placing too much emphasis on the reading.

RESPONSE (FAST, SLOW):

The response determines how quickly the unit responds to fluctuating noise. Fast has a time constant of 125 milliseconds. Slow has a time constant of 1 second.

Example: Typically, noise is not constant. If you were to try to read the sound level without a response time, the readings would fluctuate so much that determining the actual level would be extremely difficult. Using a response of slow or fast simply smooths the noise fluctuation and makes the sound level easier to work with. While the terms slow and fast have very specific meanings (time constraints), they work very much as you would expect. The fast response would result in a more fluctuating sound level reading than would the slow response. The OSHA regulations require the slow response. Refer to figure 1.

Fig. 1. Fast, Slow and Peak response to a square burst input



SEL:

The sound exposure level averages the sampled sound over a one second period. Assuming the sampled run time to be greater than one second, SEL is the equivalent one second noise that would be equal in energy to the noise that was sampled. SEL is typically measured using a 3dB exchange rate without a threshold. (SEL is not used by OSHA).

Example: Suppose you wanted to measure in a location next to railroad tracks which also happened to be in the takeoff path of an airport. A train passes by taking 10 minutes with an average sound level of 82dB. A jet passes overhead taking 45 seconds with an average level of 96dB. Which of these events results in more sound energy? You can answer the question by comparing their SEL readings which compress each event into an equivalent one second occurance. (SEL for the train = 109.7dB, SEL for the jet = 112.5dB).

THRESHOLD (CUT OFF):

The threshold affects the LAVG, TWA, and DOSE measurements. All sound below the threshold is considered nonexisting noise for the averaging and integrating functions. The threshold does not affect measurements in the sound level mode.

OSHA uses two different thresholds. The original Occupational Noise Exposure Standard (1971) used a 90dB threshold and called for engineering controls to reduce the noise levels if the eight hour TWA was greater than 90dB. The Hearing Conservation Amendment (1983) uses an 80dB threshold and calls for a hearing conservation program to be put in place if the eight hour TWA exceeds 85dB (50% dose). The Hearing Conservation Amendment is the more stringent of the two rulings and is what most US industrial users are concerned with.

Example: With an 80dB threshold, suppose you placed a 79dB calibrator on the unit for a period of time. Because all of the noise is below the threshold, there would be no average (you can think of it as an average of 0dB). If the calibrator were 80dB instead, then the average would be 80dB. On histogram printouts, typically 1 minute (or other specified increment) averages are printed. Because real noise fluctuates, it is quite possible to have an average level below the threshold. This also applies for the overall LAVG.

TWA:

The time weighted average always averages the sampled sound over an 8 hour period. TWA starts at zero and grows. The TWA is less than the LAVG for a duration of less than eight hours, exactly equal to the LAVG at eight hours, and grows higher than LAVG after eight hours. [TWA represents a constant sound level lasting eight hours that would result in the equivalent sound energy as the noise that was sampled.]

Example: Think of TWA as having a large 8 hour container that stores sound energy. If you run a dosimeter for 2 hours, your LAVG is the average level for those 2 hours - consider this a smaller 2 hour container filled with sound energy. For TWA, take the smaller 2 hour container and pour that energy into the larger 8 hour TWA container. The TWA level will be lower. Again, TWA is ALWAYS based on the 8 hour container.

When measuring using OSHA's guidelines, TWA is the proper number to report provided that the full workshift was measured.

Example: If the workshift is 6.5 hours long, then measure for the entire 6.5 hours. TWA is the correct level to report to OSHA. It does not have to be modified.

WEIGHTING:

"A", "B", "C", AND LINEAR are the standard weighting networks available. These are frequency filters that cover the frequency range of human hearing (20Hz to 20 kHz).

"A" weighting is the most commonly used filter in both industrial noise applications (OSHA) and community noise regulations. "A" weighted measurements are often reported as dBA. The "A" weighted filter attempts to make the dosimeter respond closer to the way the human ear hears. It attenuates the frequencies below several hundred hertz as well as the high frequencies above six thousand hertz

"B" weighting is similar to "A" weighting but with less attenuation. The "B" weighting is very seldom, if ever, used.

The "C" weighting provides a fairly flat frequency response with only slight attenuation of the very high and very low frequencies. "C" weighting is intended to represent how the ear perceives sound at high decibel levels and is often used as a "flat" response when LINEAR is not available. "C" weighted measurements are often reported as dBC.

LINEAR is thought of as having a flat frequency response curve over the entire measurement frequency range. LINEAR is most commonly found on upper model sound level meters and is typically used when performing octave band filter analysis.

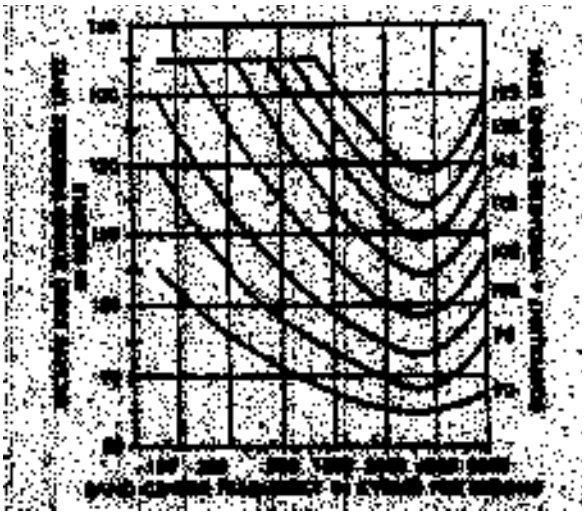
DEPARTMENT OF LABOR OCCUPATIONAL NOISE EXPOSURE STANDARD

(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, Subpart G, 36 FR 10446, May 29, 1971)

(Editor's note: The department of Labor's noise exposure standard first was promulgated under the Walsh-Healey Public Contracts Act. It was adopted under the Occupational Safety and Health Act on May 29, 1971, and is applicable under the general industry, construction, and longshore standards. A new standard has been proposed).

§ 1910.95 Occupational noise exposure

(a) Protection against the effects of noise exposure shall be provided when the sound level exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:



Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table I. G-16.

(b) (1) When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

Table G-16. Permissible Noise Exposures[1]

Duration per day, hrs.	Sound Level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

[1]When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C1/T1+C2/T2 Cn/Tn exceeds the limit value Cn indicates the total time of exposure at a specific noise level, and Tn indicates the total time of exposure permitted at the level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.