

## Occupational Health Glossary

### **A weighting**

One of the standard frequency correction curves (or weighting) applied to sounds in a measurement device to simulate the hearing capability of the human hearing mechanism. The A weighting is the most common frequency weighting used in sound level measurements and is found in virtually every sound level meter. Other frequency weightings include the 'B', 'C' and 'Z' curves.

### **Absorption**

The property of all materials that allows a reduction in the amount of sound energy reflected from it. Incident sound energy is turned into heat inside the material during the absorption process.

### **Absorption coefficient**

A measure of the sound-absorbing ability of a surface. It is defined as the fraction of incident sound energy absorbed or otherwise not reflected by a surface. The value of the absorption coefficient varies in the range from about 0.01 for marble to 1.0 for a room covered in foam sound wedges.

### **Accuracy**

The degree with which a measuring instrument obtains the "true" result. When noise measurements are carried out using a noise meter this will be the dB value representing the true sound pressure plus or minus the error at the time of the measurement. The acceptable limits for the accuracy (or error) of an instrument are usually specified in national and international standards issued by independent bodies such as ANSI or IEC. For noise meters they will cover frequency response, effect of the direction of sound arriving at the instrument and other various environmental effects such as temperature and ambient air pressure.

### **ACGIH**

The American Conference of Governmental Industrial Hygienists organization in the United States.

### **Acoustics**

The science of sound, including the generation, transmission and effects of sound waves, both audible and inaudible.

### **Acoustic trauma**

The damage to the hearing mechanism caused by a sudden burst of high-energy noise such as a blast or gun fire. The term is usually considered to be caused by a single impulsive event with a very high peak sound level.

### **Action level (dB)**

The 8 hour continuous notional noise level at which the employer must undertake certain duties of care for exposed workers. Typical values are 85 and 90 dB measured for a whole working day with the 'A' frequency weighting.

### **AED**

The aerodynamic diameter (of particles) usually expressed in microns (millionths of a meter).

### **Aerosol**

A finely divided material suspended in air or other gaseous environment.

### **Airborne sound**

Sound energy that reaches the point of interest by propagation through air.

**Air monitoring**

Sampling for pollutants in the air using a variety of means such as sorbent tubes, bags, filters and sampling conventions.

**Air pollutant**

Any substance in air that could, in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of airborne matter capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or in combination.

**Air pollution**

The presence of contaminant or pollutant substances in the air that do not disperse properly and interfere with human health or welfare, or produce other harmful environmental effects.

**Air quality monitoring**

Sampling, measurement/analysis of airborne pollutants.

**Air quality standards**

The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

**Airborne particulates**

Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Airborne particulates include: windblown dust, emissions from industrial processes, smoke from the burning of wood and coal, and motor vehicle or non-road engine exhausts.

**Alveoli**

The tiny sacs of air in the lungs where gaseous exchange takes place. Oxygen is taken into the body and carbon dioxide is expelled.

**Ambient air**

Any unconfined portion of the atmosphere: open air, surrounding air.

**Ambient sound**

The total amount of all noise present at a particular place and time in the environment at the point of investigation.

**Ambient temperature**

Temperature of the surrounding air or other medium.

**Amplitude**

The "strength" of a sound signal as detected by the ear or as measured by a sound level meter.

**Analog display**

A form of readout device that uses a needle moving across a pre marked scale to indicate the instantaneous sound level in decibels. Analog display movements are particularly prone to mechanical damage and are not typically used in higher quality instruments any more. Usually only a single parameter can be displayed on an analog display and so they are only fitted to simple instruments that show the current noise level.

**Anechoic chamber**

An enclosed space or room that has walls and floors made from nearly perfect absorbing materials. In this case it is possible to obtain almost free field conditions indoors.

**ANSI**

The American National Standards Institute in the United States. This organization publishes a wide variety of documents covering the specifications of the instruments used to make physical measurements of noise under a wide variety of conditions.

**Aromatic**

A type of hydrocarbon, such as benzene or toluene, added to gasoline in order to increase octane. Some aromatics are toxic.

**Articulation index**

A numerically calculated measurement of the intelligibility of transmitted or processed speech. It takes into account the limitations of the transmission path and the background noise at the point of interest. The index can range between 0 and 1.0. If it is less than about 0.1 speech intelligibility is generally low. If it is above about 0.6 speech intelligibility is generally high.

**Asbestos**

A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled.

**Asbestosis**

A disease associated with inhalation of asbestos fibers. The disease makes breathing progressively more difficult and can be fatal.

**ASHRAE**

The American Society of Heating, Refrigeration and Air-Conditioning Engineers in the United States.

**Aspirated**

Forced airflow over or through a sensor.

**Aspirated adaptor**

An attachment to a sampling pump or other particulate monitor that includes a small motor driven fan to force air through the sampling head to ensure good readings when used in still air situations.

**Asthma**

A condition marked by labored breathing, constriction of the chest, coughing and gasping usually brought on by allergies.

**ASTM**

The American Society for Testing and Materials in the United States. This organization publishes a wide variety of standards outlining the methodologies to be adopted when carrying out noise measurements in practice.

**Attenuation**

The reduction of sound energy by a variety of means such as air, humidity, porous materials, distance etc.

**Audio frequency**

The frequency of oscillation of an audible sound wave usually considered being within the range from 20 Hz to 20 kHz.

**Audiogram**

A graphical representation of the hearing acuity of an individual as a function of level versus frequency for each ear separately.

**Audiometer**

A measuring instrument that is used to carry out audiometric testing of the hearing acuity of individuals. These instruments can be manually operated or can be completely automatic.

**Average noise level**

The single number value of the sound over a specified interval of time averaged with a chosen exchange rate (or Q factor) that represents the noise energy of the noise as it actually varied with time.

**B weighting**

One of the standard frequency correction curves (or weightings) applied to sounds in a measurement device to simulate the hearing capability of the human hearing mechanism. The B weighting is hardly ever used for noise measurements nowadays. Other frequency weightings include the 'A', 'C' and 'Z' curves.

**Background noise level**

The total noise level of all sources other than that caused by the specific noise of interest. The unit called the 90th percentile noise level, L90%, often identifies this.

**Back pressure**

The differential pressure drop across a restriction, such as a filter in an air cassette, normally measured in inches of water.

**Band**

Any range of values such as in the frequency spectrum for noise measurements. For example, the band from 20 Hz to 20,000 Hz.

**Band pass filter**

A filter for noise measurements that has a single transmission band extending from a lower cutoff frequency greater than zero to some finite upper limit or cutoff frequency.

**Barrier**

A physical obstruction to the transmission of a stimulus between a source and a receiver. Such barriers in the case of noise can be placed by the side of roads or rail lines to reduce the levels of unwanted noise exposure to local residents living close to such sources.

**Black globe temperature**

The temperature within a matt black, hollow sphere. It measures the radiant temperature of the ambient air.

**Breathing zone**

The volume within about 8 inches (200 mm) of the operator's mouth or nose.

**Broadband noise**

Noise with components over a wide range of frequencies, the overall noise without any noticeable tonality.

**Broadband noise level**

The single number overall measurement of all noise in the audible range (20Hz to 20kHz) measured with one of the standard broadband frequency weightings. This is typically carried out using the 'A' weighting network in a sound level meter.

**BSI**

British Standards Institute in the UK.

## **Building acoustics**

The science of the behavior of sound within enclosed spaces, such as the size, shape and amount of noise that determines the audibility and perception of speech and music within the room.

## **C weighting**

One of the standard frequency correction curves (or weightings) applied to sounds in a measurement device to simulate the hearing capability of the human hearing mechanism. The C weighting is most often used for the measurement of transient or impulsive noise levels. It is specified in certain noise standards for the response of the meter to peak noise measurements since it has a defined characteristic unlike the linear (or un-weighted) frequency weighting. Other frequency weightings include the 'A', 'B' and 'Z' curves.

## **Calibration**

The process of checking a noise measuring instrument by applying a signal of known level and frequency to verify its operation in the field. Any drift from the nominal reading is usually corrected prior to measurements starting by means of a change to the displayed level shown by the meter. Some standards require that the measurement instrument be also checked at the end of a measurement to verify that no significant drift has taken place during the measurement run. Over a typical 8 hour workplace exposure noise measurement a drift from start to end of more than 1 dB may be considered to be significant and the cause should be investigated. Reasons for the drift in the sensitivity of the instrument could be large fluctuations in the local environmental conditions or a fault in the microphone capsule. Calibration can also apply to an air sampling pump to verify the flow rate before and after a measurement so that the total volume of air drawn through the sample filter is known correctly.

## **Calibrator**

A stand-alone instrument that is used to perform a field check of the overall sensitivity of a measurement device. For noise meters, these devices usually produce a single tone at a single frequency but can have multiple frequencies and levels to verify the meter. The most popular level for an acoustic calibrator is 114 dB and an operation frequency of 1 kHz. If a second level is available it is often at a value of 94 dB also at 1 kHz. For air sampling a calibrator can be a rotameter with a floating ball in a tube or a more accurate electronic device that times the flow of a piston in a precisely machined tube.

## **Carbon absorber**

An add-on control device that uses activated carbon to absorb volatile organic compounds from a gas stream. (The VOC's are later recovered from the carbon.).

## **Carcinogen**

Any substance that can cause or aggravate cancer.

## **Celsius scale**

A range of temperatures over a 100-degree range expressed as 0 degrees at the freezing point and 100 at the boiling point for pure water at standard atmospheric pressure 1013 mbar.

## **Centigrade scale**

A range of temperatures over a 100-degree range expressed as 0 degrees at the freezing point and 100 degrees at the boiling point for pure water at standard atmospheric pressure. Now more commonly referred to as the Celsius scale.

**Chart recorder**

A hard copy device that is usually fitted with a continuous roll of preprinted paper on a roll graduated in scales that allow the level of the input signal at a particular elapsed time to be determined from a pen trace recorded onto the paper. Typical chart recorders use the dc output from a noise meter or dust monitor to drive the pen mechanism backwards and forwards across the width of the paper roll in sympathy with the changing signal levels.

**Chronic effect**

An adverse effect on a human or animal in which symptoms recur frequently or develop slowly over a long period.

**Chronic exposure**

Multiple exposures occurring over an extended period of time or over a significant fraction of an animal's or human's lifetime (Usually seven years to a lifetime).

**Climate change**

The term 'climate change' is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, 'climate change' has been used synonymously with the term, 'global warming'; scientists however, tend to use the term in the wider sense to also include natural changes in climate.

**Cochlea**

Part of the human hearing mechanism located within the inner ear that contains the receptor organs essential to the hearing process. It is shaped like a small snail and contains the hair cells that detect the sound vibrations and convert a mechanical motion into nerve impulses that are sent to the brain for interpretation as sound patterns and noise identification.

**Community noise equivalent level**

A twenty four hour, single number, equivalent noise level usually calculated from measured hourly equivalent noise levels where certain corrections have been added to the evening and night time noise intervals to represent a penalty factor. The evening period defined from 1900 to 2200 has a penalty of 5 dB added to the measured levels while the night time period of 2200 to 0700 has a 10 dB penalty added. Thus a higher overall level is obtained for the complete 24 hours compared to the actual measured hourly levels obtained by normal logarithmic addition of the 24 separate Leqs. Other shorter periods can be combined to produce the overall CNEL as long as the appropriate corrections are applied depending on the time of day that they were collected, for example 15 minute or 5 minute periods that will provide more detail when inspected at a later time.

**Compact Flash cards**

Digital memory cards with storage capacity for data results from certain measurement systems such as the Casella Nomad Portable Weather Station. Capacities vary from 16Mbyte up to as much as 1 Gbyte on a single small form factor card. There are no moving parts in a Compact Flash (or CF) card so they are much more rugged and reliable in field and portable instruments designed for outdoor usage.

**Compliance monitoring**

Collection and evaluation of data, including self-monitoring reports, and verification to show whether pollutant concentrations and loads contained in permitted discharges are in compliance with the limits and conditions specified in the permit.

**Compound**

Chemical combination of different elements to form a substance where the compound atoms cannot be separated by physical means. Such compounds are not necessarily stable and may decay into other simpler compounds.

**Concentration**

The amount of a contaminant in a unit measurement. For example, the mass in grams of particulates in a standard cubic meter of volume of air. This is referred to as mg/m<sup>3</sup> since there is not usually enough particulate present to get beyond a few tenths of a gram in mass.

**Conical inhalable sampling head**

The conical inhalable sampling head uses a 37mm GFA filter to collect samples of air in the breathing zone when used in conjunction with a personal sampling pump.

**Constant bandwidth filter**

A band-pass filter whose bandwidth is independent of the band center frequency. FFT analyzers are typical examples of such filters used for the analysis of vibration sources. Every filter in such an analyzer would have the same bandwidth, for example, 10 Hz wide or 100 Hz wide. The total measurement range will therefore be split up into equal parts with the same absolute resolution. For acoustic measurements across the normal range from 0 Hz to 20 kHz with a 10 Hz constant bandwidth filter there would be  $(20000/10) = 2000$  separate results.

**Constant percentage bandwidth filter**

A band-pass filter whose bandwidth is a constant percentage of the band center frequency. Whole octave or third octave filters are examples of such filters used for the analysis of acoustic sources. In this case, every filter represents a constant percentage of the center tuned frequency in an octave band analyzer. Octave band analyzers are sometimes referred to as such filters since the range of frequencies passed by the selected filter is always about 70% of the center frequency chosen by the user. For the 1 kHz octave band filter the bandwidth is from about 700 Hz to about 1,400 Hz.  $(1414 - 707 = 700 \text{ Hz}, 700/1,000 = \sim 70\%)$ . For the 16 kHz octave the range is still about 70% but this represents a much larger range of frequencies than that for the lower frequency bands.

**Contaminant**

Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

**Contamination**

Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use. Also applies to surfaces of objects, buildings, and various household and agricultural use products.

**Crest factor**

This is the ratio between the peak level of an acoustic signal and its energy equivalent, or rms, level. For a continuous sine wave the peak level is 3 dB higher than the rms level when measured in logarithmic terms. When measured in linear unit terms the peak level is 1.41 (square root of 2) times the rms. value. For an impulsive signal such as a blast or an impact sound the peak level can easily exceed the rms level by 25 or 30 dB.

## **Criterion level**

The level of equivalent steady noise that lasts for exactly 8 hours that represents the allowable daily noise exposure or PEL. For OSHA compliance this level is usually taken to be an A weighted noise level of 90 dB but other lower levels are also specified in other regulations. The criterion level is the equivalent decibel level for the 100% noise dose value for the criterion duration of 8 hours.

## **Cumulative**

The total or overall sound level for the whole of a noise measurement interval from the start time to the stop time including everything that occurs during the measurement run.

## **Cumulative distribution**

A distribution of samples of the instantaneous noise level taken at regular intervals during a measurement where the samples are arranged according to their percentage of occurrence. The distribution ranges from 100% to 0% as the dynamic range increases. The 100% point will represent the lower end of the range while the 0% will describe the higher end of the range. There needs to be a suitably large number of samples to construct a distribution to obtain the best estimate of the answer required. While it is possible to calculate a LN10% result from a distribution of only 10 readings it will be much better to have at least 1000 results in the interval of time to calculate the LN10%. Modern instruments typically sample at 100 times a second when directly calculating the distribution so intervals of more than 10 seconds will usually produce valid results for LN% values.

## **Cumulative distribution level**

A distribution of samples of the instantaneous noise level taken at regular intervals during a measurement and classified according to occurrence at increments of amplitude. Typical increments of level are either 1 or 0.5 dB intervals across the measured dynamic range of the instrument plus an over range and under range counter. An instrument with a 70 dB dynamic range classifying samples at 0.5 dB intervals plus over and under range values will have 143 separate bins to store and classify the samples. At least 1000 samples (or preferably many more) are typically needed to produce reliable values for the percentile noise levels generated from such a distribution table.

## **Cutoff frequency**

The frequencies that mark the end of a band or the point at which the characteristics change from a pass to a no-pass band. For example, for an octave filter in a sound level meter centered at 1 kHz the lower cutoff frequency will be 707 Hz and the upper cutoff frequency will be at 1,414 Hz. In an idealized filter all other frequencies below and above these two limits will be severely attenuated or completely removed.

## **Cutoff level**

The sound level at which a noise dosimeter starts to accumulate sound into the calculations used to measure a personal noise dose reading. All levels of noise below the cutoff level will be treated as if they were 0 dB and excluded from the calculation of the noise dose value according to the requirements of the OSHA workplace noise standards. Thus, if the noise level is continuous at 79 dB all day there will be no contribution to the day's dose because the readings do not exceed the 80 dB cutoff level. The cutoff level is also known as the threshold value. Even though the level below the cutoff is counted as zero contribution the time must still be included in the overall exposure results.



**Cycle**

The complete sequence of values of a periodic quantity that occurs during one single period.

**Cycles per second**

A measure of the frequency of a tone and numerically equivalent to Hertz, the preferred unit of frequency according to international standards.

**Cyclone head**

A device that uses centrifugal force to remove large and heavier particles from polluted air. The smaller size particles pass up the cavity and are deposited on the filter membrane. Cyclones are designed to separate out the respirable size particles below about 4 microns such that the larger sized particles are not included in the measurement and are rejected by the sampling head.

**Daily personal noise exposure level**

The general name for the level of the amount of noise exposure that an operator is subjected to measured at the workplace. Limits vary according to various national and international Health and Safety regulations for the amount of exposure that is considered allowable for an operator without hearing protection. Typical limit values are an equivalent steady level of 85 or 90 'A' weighted dB for an 8-hour working day. This is also known as the LEP,d or the Lex8hr.

**Damping**

The dissipation of noise energy with time or distance. The term is usually applied to the attenuation of sound in a structure owing to the internal sound-dissipative properties of the structure or to the addition of sound-dissipative materials.

**Data logging**

The collection of a regular series of data points during a recording to enable the temporal variations of the measured values to be studied. This can be in a personal noise dosimeter, a heat stress monitor, a real time dust or particulate monitor or a weather monitoring system. All of these examples show the benefit of knowing when certain measured values occurred in order to apply corrective measures properly. Data logging can be done as rapidly as every second for fast changing acoustic signals or as slow as every hour for more slowly varying weather parameters such as atmospheric pressure.

**Day night noise level**

The 24 hour average noise level of all hourly Leq measurements with a 10 dB penalty added to the levels between 2200 and 0700 hours to reflect people's extra sensitivity to noise during the night. No correction is added to the measured Leq levels taken between the hours of 0700 and 2200 in arriving at the overall single number.

**dB**

The abbreviation of the decibel used to express the level of a noise or sound. It is a logarithmic quantity that represents the ratio of the actual measured sound pressure (p) to a nominal reference sound pressure (p<sub>0</sub>). The accepted reference sound pressure is taken to be 20 µPa (0.000,020 Pa). The definition of the decibel is given by;

$$\text{dB} = 20 \log_{10} (p/p_0)$$

**decibel**

The unit of sound pressure level usually abbreviated to the dB. Any noise quantity that is expressed as a "level" is measured and quoted in decibels.

**Density**

A measure of how heavy a solid, liquid, or gas is for its size. Measured as mass per unit volume, e.g.. lb/cu ft or kg/m<sup>3</sup>.

**Dew point**

The temperature at which the water vapor in the air first starts to condense. Typically expressed in degrees Fahrenheit or Celsius. The dew points indicate the amount of moisture in the air. The higher the dew point, the higher the moisture content of the air at a given temperature. Dew point temperature is defined as the temperature to which the air would have to cool (at constant pressure and constant water vapor content) in order to reach saturation. The warmer air is, the more water vapor it can "hold."

**Diffraction**

Radiation being bent or curved from its original course, for example light as it passes through a narrow slit. Also a modification which sound or light waves undergo in passing by the edges of solid obstacles or particles in their path from source to receiver.

**Diffusion tubes**

An inert tube of plastic or stainless steel that contains an absorbing matrix capable of collecting specific target air pollutants. The tubes are used for ambient air monitoring and sent to a laboratory for analysis.

**Digital audio tape**

A form of closed tape recording system using small tape cassettes with a fixed recording duration. The dynamic recording quality is approximately 75 dB from tape saturation to noise floor. This matches the output range from most current sound level meters. Up to 4 hours of continuous recording can be possible at half speed recording.

**Dry bulb temperature**

The temperature reported by a thermometer shielded from the direct rays of the sun or other radiant sources that measures the temperature of the local air.

**Digital signal processing**

A digital computation carried out on samples of the raw sound measured by certain sound level analyzers that can be used to derive the common units of instantaneous, maximum, minimum and average level etc. Typical DSP calculations are carried out many times a second to derive small packets of noise that can be recombined to obtain the more popular values found in more conventional sound level meters. The adoption of proprietary algorithms can yield the frequency contributions contained within the short samples. Rates as fast as sampling at 76,800 times per second are common in many analyzers generating small samples every 5 or 10 μseconds.

**Directivity**

Unless a noise source is completely omni-directional there will be some of the sound energy that is radiated more in certain directions than in others.

**Directivity index**

In a given direction from a sound source under consideration the directivity index is the difference in decibels between the sound pressure level produced by the source in that direction and the space averaged sound pressure level of that source measured at the same distance. This unit is often used in predicting noise levels away from a source of known output and directivity when performing noise control.

## **DOD**

The Department of Defense of the United States. A specific set of measurement settings in a noise monitoring instrument used to measure the exposure of certain military personnel to noise in their workplace.

## **Doppler effect**

The apparent upward, or downward, shift in frequency of a sound as the relative positions of the source and receiver change with respect to each other. This is most noticeable for a passenger standing on a railway platform as a speeding train approaches and recedes the station. The apparent frequency increases quickly as the source approaches the receiver and decreases as the source moves away. The faster the source is moving the more noticeable will be the change of frequency. The Doppler effect is also heard when the source is stationary and the receiver is moving such as a car passing by a steam exhaust venting to atmosphere.

## **Dose**

A relative measurement of the noise in a workplace usually expressed as a percentage of some allowable total daily value. Noise dose is analogous to radiation dose as a hazard in the workplace.

## **Dose badge**

A small lightweight personal noise dosimeter that has the microphone built in to the body of the unit so preventing problems with cables when worn by a worker in a noisy environment. A separate reader unit may be required to control the noise dose badge and to access the stored results. Other badge style dosimeters may have a display builtin so that they are not dependent on a special reader unit to retrieve the results.

## **Dosimeter**

A measurement instrument capable of being worn by a mobile worker or operator during the day to measure the total exposure of that operator to noise in the workplace. Traditionally, the dosimeter is supplied with a microphone on a cable that allows the measurements to be carried out in the hearing zone of the individual. The body of the dosimeter is worn on the belt or in a pocket or pouch. A noise dosimeter is essentially the same as a standard sound level meter except that it is normally designed to only measure the broadband noise levels without performing any sort of frequency analysis. Newer badge style dosimeters may have the microphone capsule builtin to the body of the instrument and be worn on the shoulder directly and not on the belt.

## **Duration**

The elapsed time from the start of a measurement run to the end of that run. Measurement durations can be from a few seconds up to several hours or even days depending upon the application. The duration of the measurement can be specified in a standard or may be calculated by knowing the process under investigation. If noise is cyclical in nature then at least one or two complete cycles should be measured to be sure of correctly classifying the noise climate.

## **Dust**

Solid particles, usually produced by a mechanical process, with a range of particle diameters from 0.1 to 100 microns. Dust can also include fumes that condense from the vapor state usually from the volatilization of molten metals, high boiling liquids or combustion.

## **Ear**

Cross section of the typical human ear showing the hearing mechanism that concentrates the sound waves and directs them to the inner ear for detection and recognition as speech or music or warnings.

**Ear muffs**

Personal hearing protectors that are worn over the whole of the outer ear to minimize hearing loss in high noise levels. These hearing protectors are usually connected by a strong metal band to maintain an adequate tight fit over the ears.

**Ear plugs**

Personal hearing protectors that are worn inside the ear canal of the outer ear to minimize hearing loss in high noise levels. These are usually made of foam that is first compressed and then inserted into the ear canal where they can expand and take up the right shape for each ear they are used in.

**EC**

The European Community.

**Echo**

A wave that has been reflected or otherwise returned with sufficient magnitude and delay so as to be detected as being distinct from the direct wave at the point of interest. If the echo arrives too late after the direct wave then the intelligibility of the sound or speech will be adversely affected.

**Ecosystem**

The interacting system of a biological community and its non-living environmental surroundings.

**Enclosure**

A complete box structure around a noise source for the purpose of keeping the noise levels at a certain point lower than they would otherwise be without the enclosure. Typical enclosures are constructed from wood, metal, brick depending upon how much attenuation of the source noise is required to be obtained.

**EPA**

The Environmental Protection Agency in the USA.

**Epidemiology**

Study of the distribution of disease, or other health-related states and events in human populations, as related to age, sex, occupation, ethnic, and economic status in order to identify and alleviate health problems and promote better health.

**Equal loudness curves**

Lines of equal sensation of loudness plotted on a chart of decibels versus frequency to show the subjective impression of different sounds. The human hearing mechanism is less sensitive to sound at low and high frequencies and more sensitive to the range of frequencies between 250 to 5,000 Hz. The equal loudness curves vary in gradient depending upon the overall level of noise becoming more linear as the noise level rises.

**Equivalent continuous noise level**

The notional constant single level, in decibels, that represents the same sound energy as the actual varying sound over a specified interval of time. The steady level  $L_{eq}$  is equivalent in energy to the "real" actual varying noise level over the specified period of time. The  $L_{eq}$  is usually expressed as an 'A' weighted value in dB unless the frequency response is specified otherwise, e.g.  $L_{Ceq}$ . The  $L_{eq}$  can also be measured in individual octave or third octave bands during a frequency analysis of a noise source for noise control purposes.

**Equivalent method**

Any method of sampling and analyzing for air pollution which has been demonstrated to the relevant regulators satisfaction to be, under specific conditions, an acceptable alternative to normally used reference methods.

**Errors**

When properly defined, the term "error" pertains only to physical measurements, that is to estimating anything where exactness is not possible. Measurement errors are unavoidable even for the most thoroughly trained and motivated measurer. They occur to some extent in virtually every physical measurement because of imperfections of the instruments used and the person undertaking the measurement, as well as the influences of the natural environment. Errors may be defined in terms of a fixed error or as a percentage of the reading taken. Errors in a measurement system can be systematic or random depending on the cause.

**EU**

The European Union.

**Exceedance noise level**

The calculated noise level based on sampling the varying noise climate and expressing the result as a percentage of time above the chosen statistical level. For example, the LN10% is the noise level exceeded for 10% of the measured time interval. The samples of the noise are sorted into a distribution table at fixed dB intervals and the statistics are calculated from the cumulative distribution curve that is produced. The LN90% is often used to describe the background noise level in noise measurements. The LN50% describes the median noise level with half the samples being above and half the samples being below this level. Because of the logarithmic nature of noise measurements with the decibel scale the LN50% is not the same as the average noise level.

**Exchange rate**

This is the number of decibels used in the calculation of the average noise level that is taken to represent the doubling (or halving) of the risk when used in personal noise dosimetry measurements. Possible values for the exchange rate are currently 3, 4 or 5 decibels. An exchange rate of 6 dB is very occasionally found in certain instruments but is not commonly used. See also, "Q" for more information.

**Extractive monitoring**

Measurement made on a sample that is taken from a stream or flow.

**Fahrenheit scale**

A range of temperatures over a 180-degree range expressed as 32 degrees at the freezing point and 212 at the boiling point for pure water at standard atmospheric pressure.

**Far field**

The far field is a notional volume around a noise source such that the inverse square law applies to the dissipation of the energy. In this region the measured sound level reduces at a rate of 6 dB every time the distance from the source doubles. In the far field region the particle velocity of the molecules is in phase with the sound pressure.

**Fast response**

This is one of the standard responses in a sound level meter (or dosimeter).

**Fast weighting**

The fast weighting is the same as the fast response in a sound level meter and is part of the rms. circuit controlling the response of the meter to the variability of the instantaneous levels of the

noise. It has a value of 125 milli seconds and is a continuous function that is calculated all the time by the instrument.

### **Filter cassette**

A mechanical container designed to minimize the handling of the delicate filters used in sampling for particulates. Filter cassettes are available in various sizes such as 25 mm, 37 mm or 47 mm.

### **Filters**

Can be made from glass fiber (GF/A) or mixed cellulose ester (MCE). Used to collect the particulates in the air when performing sampling conventions. Usually used in 25 or 37 mm diameter sizes.

### **Filter set**

A device for separating the different components of a signal on the basis of their frequency. It allows components in one or more frequency bands to pass relatively un-attenuated while it attenuates components in other frequency bands.

### **Flanking noise**

Noise that is transmitted from one room into another by indirect means such as through sidewalls or floors rather than through the common partition that separates the rooms.

### **Flow meter**

A device used to verify the flow rate of a personal sampling pump used for sampling conventions to ensure stable and well-known conditions.

### **Free field**

Sound fields in which the effects of walls or other obstacles or boundaries on sound propagation are negligible. As a measurement point moves away from a source the noise level will drop according to the inverse square law.

### **Frequency**

The number of times a second that a sine wave of sound repeats itself, or a vibrating object, repeats itself. The more repeats per second then the higher the frequency is said to be. The unit of frequency is Hertz, Hz, numerically equal to the earlier unit cycles per second, cps.

### **Frequency band**

A range of frequency components in the audio bandwidth used to characterize different noise sources. Frequency bands can be expressed as whole octaves, third octaves, sixth octaves etc. For noise measurements to assess the affect on humans the step intervals for contiguous frequency bands are usually expressed on a logarithmic scale.

### **Gas**

Material that is in the gaseous phase under the surrounding conditions.

### **Global warming**

The term 'climate change' is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, 'climate change' has been used synonymously with the term, 'global warming'; scientists however, tend to use the term in the wider sense to also include natural changes in climate.

### **Globe temperature**

The temperature reported by a thermometer mounted inside a small matt black globe that measures the radiant heat in an area.

## **Gravimetric analysis**

The determination of the mass concentration of particulates using pre and post weighed filters. The sample filter is weighed before the measurement and again after the dust sample has been collected in the cassette. The difference between the weights is the mass of dust/particulate collected during the sampling interval. The total volume containing the dust sample is obtained from the flow rate of the device (usually a personal sampling pump) by multiplying the flow rate in l/min by the time in minutes. This gives a volume in cubic meters. The concentration value is therefore the mass divided by the volume and is usually expressed in mg/m<sup>3</sup>.

## **Hand held measurements**

Measurements made over a short period of time where the monitoring instrument is held in the users hands as opposed to being permanently mounted on a tripod or on a bench. usually measurements like this are done in 5 to 10 minutes at each position.

## **Harmonic**

A sinusoidal component whose frequency is a whole number multiple of the fundamental frequency of the wave. If a component has a frequency that is twice that of the fundamental it is referred to as the second harmonic.

## **Hearing**

The subjective response of human beings to acoustic energy or sound waves. The hearing capability of an individual must be protected against high noise levels to prevent it from deteriorating over time when working in noisy environments.

## **Hearing conservation program**

A planned program to document the noise exposure of employees with the purpose of ensuring that all are adequately protected from the harmful effects of high noise levels in the workplace. Possible outcomes of such a program could include the prescription of suitable hearing protectors, the attenuation of noisy machinery or the rotation of job functions between different workers during the day.

## **Hearing level**

A measured threshold of hearing at a specified frequency, expressed in decibels, relative to a specified standard of normal hearing. The deviation of an individual's threshold from the zero reference level in the audiometer.

## **Hearing loss**

The general term for the impairment of hearing acuity. The amount of this hearing acuity, in decibels, measured as a set of hearing threshold levels at specified frequencies. Hearing loss can be caused by a number of factors such as loss in the conductive mechanisms in the ear, loss originating in the sensori-neural parts of the auditory nerves or by excessive exposure to high noise levels at work.

## **Hearing protectors**

Devices worn by an individual to protect against excessive exposure to high noise levels. These can be of the internal or external types. Internal types include ear plugs that are inserted into the ear canal while external types are mainly ear muffs that fit completely around the ear lobes.

**Hearing threshold level**

The amount, in decibels, by which an individual's threshold of audibility differs from that of a normal standard audiometric threshold.

**Heat exhaustion**

A heat related illness characterized muscular weakness, distress, nausea, vomiting, dizziness, pale clammy skin and fainting.

**Heat stress**

The physiological strain caused by an increase in core body temperature above safe levels where the individual is at risk of overheating.

**Hertz**

The international unit of frequency of an oscillation, numerically the same as cycles per second. Abbreviated as Hz.

**HSE**

Health and Safety Executive (UK Agency)

**HVAC**

The general term for all acoustic measurements involving the subject of Heating, Ventilation and Air Conditioning.

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**IEC**

The International Electrotechnical Commission based in Switzerland that publishes numerous standards specifying the performance of sound level meters, noise dosimeters and frequency filters.

**Impact insulation class**

A single figure rating that compares the impact sound insulating capabilities of floor-ceiling assemblies to a reference contour.

**Impact sound**

The sound produced by the collision of two or more solid objects. Typical sources are footsteps on a floor or on an interior surface. Other sources can include drop forges or other metalwork processes.

**Impulsive noise**

Either a single pressure peak with a rise time of less than about 200 milli seconds (or total duration of less than 200 milli seconds) spaced by at least 200 milli seconds or a sound pressure occurring in a short interval of time.

**Impulse response**

This is one of the standard responses in a sound level meter (or dosimeter).

**Impulse weighting**

The impulse weighting is the same as the impulse response in a sound level meter and is part of the rms. circuit controlling the response of the meter to the variability of the instantaneous levels of the noise. It has a rise time value of 35 milli seconds and a decay time of 1500 milli seconds. The asymmetric nature of the impulse weighting means that any average sound level calculated based on samples of the instantaneous will be biased towards the higher noise events than will the average calculated from either the fast or slow response. It is a continuous function that is calculated all the time by the instrument.



**Indoor air**

The breathing air inside a habitable structure or conveyance.

**Indoor air pollution**

Chemical, physical, or biological contaminants in indoor air.

**Infrasonic**

Sound frequencies that are below the normal limit of human audibility, typically less than about 20 Hz.

**Inner ear**

The part of the hearing mechanism that transfers the mechanical vibrations into electrical impulses that are then sent to the brain to be interpreted as sounds. Also associated with the balance mechanism.

**Insulation**

The ability of a material to keep out sound from a given source on the other side of the material. The performance of the material depends on its composition and density, the higher the density the better the material is as a sound insulation product.

**Integrated sound level**

The average sound level over a period of time that represents the energy contained in the noise. The integrated level will be the same whether the fast or slow time weightings are used in the measuring instrument since these weightings are symmetrical for both rising and falling sound levels. Use of the impulse time weighting will produce a higher average level compared to the true energy level computed from fast or slow sampled levels.

**Integrating sound level meter**

A measuring instrument that can calculate the time average noise level over a specified period of time in addition to measuring and displaying the simple instantaneous level. Sometimes called Leq meters when the exchange rate is fixed at  $Q = 3$  dB. It is also possible to obtain the integrated sound level with the exchange rates of 4, 5 or 6 dB.

**Intensity**

The sound energy flow through unit area ( $1 \text{ m}^2$ ) in unit time (1 second).

**Inverse square law**

A description of the acoustic wave behavior in which the mean-square pressure varies inversely with the square of the distance from the source. This behavior in free field situations where the sound pressure level decreases 6 dB with each doubling of distance from the source.

**IR**

Infrared radiation beyond the limit of normal human sight. Sometimes used as a wireless communication method to transfer data from an instrument to a printer or to a computer.

**ISO**

The International Standards Organization based in Switzerland that publishes numerous standards outlining how different measurements may be carried out.

**Isokenetic sampling**

Sampling velocity equal to local gas velocity. Usually considered inside chimney stacks and other such locations.

**Isolation**

The physical separation of one item from another to prevent the flow of energy through a structure. This can be for both the control of sound or vibration energy.

**KiloHertz**

The unit of frequency measurement for signals over 1,000 Hz. 1 kHz = 1,000 Hz.

**KiloPascal**

The unit of pressure representing the force of 1 Newtons per square meter (N/m<sup>2</sup>). Standard atmospheric pressure of the air is 1.013 kiloPascals (kPa) also known as millibar (mb). 1 atmosphere is 1.013 kPa (mb) is also the same as 29.92 in of mercury.

**Lavg**

The logarithmic time average level with an exchange rate of 3, 4, 5 or 6 dB that represents the amount of noise as a single number compared to the actual varying sound level over a specified period of time. When Q = 3 the average level is called the Leq. When Q = 4 the average level is called the LDoD. When Q = 5 the average level is called the LOSHA. For a perfectly steady instantaneous noise level the values of the average levels with different Q factors will be the same.

**LEP,d**

$LEP,d = Leq(t) + 10 \log(10) t/8 \text{ hours}$

The daily personal noise exposure level as specified in European noise at work regulations. It is a measurement of the total time of exposure to noise in the workplace expressed as a constant notional equivalent 8 hour value.

**Leq**

The equivalent continuous noise level over a specified period of time that represents the same energy as the actual time varying noise signal. This is a specific form of the time average level when the exchange rate Q is set at a value of 3 dB.

**Level**

A descriptor applied to a unit of measurement of sound (or vibration) that denotes the physical quantity is a logarithmic representation of the underlying phenomenon. The decibel is normally used to denote that the value should be referred to as a level rather than the true physical quantity. The most used such value is the 'A' weighted sound pressure level expressed as a dB value.

**Level recorder**

A device that records the changing noise levels over a period of time to allow the user to see the temporal variations that occurred during the period of interest. High speed paper recorders were often used before the advent of digital data logging in some of the more advanced sound level meters. Time histories can be recorded with multi parameters as fast as every 10 milli seconds with certain newer instruments.

**Linear noise level**

The noise level in dB measured without using the 'A', 'C' or any other specified frequency weighting in a sound level meter. The linear frequency response can cover different frequency ranges depending on the quality of the microphone used in the measurement chain. The 'Z' weighting has replaced the linear weighting in more modern noise level meters.

## **Liquid crystal display**

A type of readout for the display of a sound level meter or noise dosimeter in which the values are shown on a matrix composed of a series of segments. The segments can be custom designed for a particular instrument such as the CEL noise dosimeters or it can be made up of a rows and columns of small dots that are used to form the characters such as in the CEL sound level meters. It is possible to mimic the characteristics of traditional analog displays to indicate the instantaneous level with the advantage that more than a single level can be shown in a small screen area.

## **LN%**

The notional steady level of noise exceeded for a specified percentage of the total measurement time. The value is usually found from the cumulative distribution table and so the number of sample bins used to collect the raw data in the instrument controls the resolution. For samples collected at 0.5 dB sample resolution the percentile level can only be displayed with a resolution of 0.5 dB. Typically an instrument will be able to calculate and display up to 5 LN% values but other values may be possible to obtain if the distribution table is available at download time using computer software.

## **Logarithm**

The exponent that indicates the power to which a number must be raised to produce a given number. For the base 10 logarithms as used in acoustics and the study of sound the logarithm of 100 is 2, while the logarithm of 1000 is 3, etc.

## **Loudness**

The subjective judgment of the intensity of sound by the human hearing mechanism. Loudness depends on the sound pressure and frequency of the stimulus signal. Over the normal audio range it takes about a three fold increase in sound pressure (a ten fold increase of the energy level) to produce a doubling of the impression of loudness.

## **Loudness level**

This is the measured level in phons and is numerically equivalent to the median sound pressure level of a free progressive 1,000 Hz wave presented to listeners facing the source, which in a number of trials is judged by the listeners to be equally loud.

## **Ltm3**

The taktmaximal-3 level is a time average value calculated every 3 seconds based taking the highest level occurring during the preceding three seconds and assuming that it was present for the whole of the 3 second interval. This is repeated every 3 seconds to produce a long term average level that will be higher than the equivalent continuous noise level, or Leq, depending on the impulsiveness of the sound under investigation. Comparison of the Ltm3 and the Leq will therefore give an objective measure of the impulsive nature of the noise when assessing nuisance or risk to hearing from high noise levels.

## **Ltm5**

The taktmaximal-5 level is a time average value calculated every 5 seconds based taking the highest level occurring during the preceding five seconds and assuming that it was present for the whole of the 5 second interval. This is repeated every 5 seconds to produce a long term average level that will be higher than the equivalent continuous noise level, or Leq, depending on the impulsiveness of the sound under investigation. Comparison of the Ltm5 and the Leq will therefore give an objective measure of the impulsive nature of the noise when assessing nuisance or risk to hearing from high noise levels.

## **Masking**

The process by which the threshold of audibility for a sound is raised by the presence of another masking sound.

## **Masking noise**

A noise that is intense enough to render inaudible or un-intelligible another sound that is also present. Typical uses of masking noise are between doctor's surgeries and waiting rooms to prevent those in the waiting room from hearing the intimate conversations of the patient currently talking to the doctor. Water fountains or background music are examples of masking noises for this purpose.

## **Mass law**

The amount of sound insulation afforded by a wall is proportional to the mass of the material in the wall. Broadly speaking doubling the mass (per unit area) increases the sound attenuation by 6 dB and a doubling of the frequency increases the attenuation by 6 dB. These figures are theoretical limits and in practice a 5 dB reduction is more often found.

## **Maximum exposure limit**

These are the statutory limits that should not normally ever be exceeded. MELs are particularly applied to substances known to be carcinogenic.

## **Maximum noise level**

The highest instantaneous sound pressure level over a given interval of time with a selected frequency weighting and specified time weighting. For example, an A weighted fast maximum level of 96 dB in a workshop.

## **Medium**

Any solid substance carrying a sound wave. Sound will not travel through a vacuum since there are no particles to transfer the energy from one point to another.

## **Micron**

A unit of length. One millionth of a meter or one thousandth of a millimeter. One micron equals 0.00004 of an inch.

## **Microphone**

A transducer that changes the physical motion of air molecules into an equivalent electrical signal that can be processed by a sound measurement system such as a sound level meter. Different devices have different frequency responses and sensitivities. All other things being equal a smaller diameter microphone diaphragm produces a lower electrical output signal for a given sound pressure. The sensitivity of a microphone is given as the number of Volts obtained for a reference sound pressure. Typical examples are 10 mV/Pa for a general-purpose microphone capsule.

## **Microprocessor**

An electrical component that is able to rapidly process samples of an input signal obtained from an analog to digital converter and produce an output signal proportional to the time average level, the highest level or other computed values. Typically these calculations are performed many times a second in order that none of the input signal is missed. The microprocessor is the heart of the modern digital sound level meter and controls the main functions that are performed by the instrument.

**Middle ear**

Part of the hearing mechanism comprising the three smallest bones in the human body. The “hammer, anvil and stirrup” bones form a mechanical lever with a mechanical advantage of about 1.5 between the ear drum and the oval window of the cochlea.

**Minimum noise level**

The lowest instantaneous sound pressure level over a given interval of time with a selected frequency weighting and specified time weighting. For example, an A weighted slow minimum level of 36 dB in an office.

**Monitoring**

Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants and animals.

**MSHA**

The Mine Safety and Health Administration in the USA.

**Natural frequency**

The frequency at which a system tends to vibrate with large amplitude for very small input energy. It falls at the point where a system changes from being stiffness controlled at low frequencies to being mass controlled at higher frequencies.

**Natural wet bulb temperature**

The temperature reported by a thermometer that has a wet wick over it supplied continuously with water from a reservoir.

**Near field**

The sound field close to a noise source where the sound pressure does not obey the inverse square law and the particle velocity is not in phase with the sound pressure. Measurements made in the near field can vary greatly for small changes of microphone position. This can sometimes account for the differences found in noise measurements obtained with a personal noise dosimeter and those obtained from a hand-held sound level meter when an operator stands very close to a noisy machine.

**Nephelometer**

Optical measurement device based upon the scattering effect of light by particulate.

**NIOSH**

The National Institute for Occupational Safety and Hygiene in the United States. An organization dedicated to investigating the harmful effects of varied industrial hazards on the working population and promulgating regulations to control their harmful effects.

**Noise**

Unwanted sounds at a particular place at a particular time.

**Noise dose (dose%)**

The amount of noise received by a worker during the workday expressed as a percentage of a certain reference level for a given duration. The usual allowable noise dose is typically set at 100% dose equivalent to an equivalent continuous noise level of 90 A weighted dB over a standard 8-hour working day. Other noise levels exist that are considered to represent the 100% noise dose but the time interval is almost always the 8 hour day.

## **Noise event**

The increase in the current sound level that exceeds a selected threshold value and thereby identifies a significant change in the acoustic climate. Noise events are typically considered to be significant when the instantaneous level exceeds the underlying background level by more than about 15 dB. Events may be transient and last less than a second, such as a single blast or may last for 20 to 30 seconds such as a passing train or aircraft taking off at an airport.

## **Noise exposure**

The absolute measure of the amount of noise experienced by an operator at work. It is proportional to the square of the sound pressure and the duration. It is different from noise dose in that it is an absolute measurement rather than a percentage of some chosen combination of noise level and time. Typically specified in European Noise at Work legislation and expressed in Pa2h or Pa2s. 1 Pa2h = 3600 Pa2s. a continuous noise level of 90 dB lasting for 8 hours is approximately equivalent to a sound exposure of 3.2 Pa2h.

## **Noise exposure level (LEP,d)**

The expression of noise exposure as a logarithmic term in dB. In European Noise at Work legislation it is expressed as the Daily Personal Noise Exposure level LEP,d.

## **Noise floor**

The lower limit of accurate measurement capability in a sound level meter where the effect of the inherent electrical noise is superimposed on the actual signal. It is normally quoted as the minimum level in dB that can be measured by the meter on the lowest dynamic range setting. Only results of 10 or more dB than the noise floor should be considered to be accurate in a typical sound level meter specification.

## **Noise isolation class**

A single number rating derived in a prescribed manner from the measured values of noise reduction between two areas or rooms. It provides an evaluation of the sound isolation between two enclosed spaces that are acoustically connected by one or more paths.

## **Noise level**

For sound transmitted primarily through the air it is usually taken to be the A weighted sound pressure level in dB.

## **Noise ordinance**

A document that sets out how noise in a community is to be treated in terms of limits of level, duration, times of occurrence etc during the day. Different limits may apply to day times that to night times and between residential, industrial or commercial zones. Limits may be written in terms of absolute maximum levels not to be exceeded or in terms of the difference between the background level and the offending level. A person appointed to make such measurements makes measurements with an approved sound-measuring device usually on a property boundary line.

## **Noise reduction**

The numerical difference in decibels of the average sound pressure in two areas or rooms. A complete measurement of the reduction in noise consists of the simple level difference between the two rooms due to the common partition and also takes into account the background level in the receiving room and the amount of sound absorption in the receiving room. The noise reduction is a function of frequency typically increasing with increasing frequency and is measured in third octave bands from at least 100 Hz to 3150 Hz.

**Noise reduction coefficient**

A measure of the acoustical absorption performance of a material calculated by averaging its sound absorption coefficients at 250, 500, 1000 and 2000 Hz and expressed to the nearest multiple of 0.05.

**Noise reduction rating**

A single number rating value based on the difference between the A and the C weighted overall noise levels. The difference in the readings obtained with a suitably equipped sound level meter will vary depending upon the frequency distribution of the subject noise and its spectrum particularly in the lower frequency bands. For a sound with a lot of low frequency components the C weighted level will be higher than the A weighted sound level. An increase in the A weighted level over the C weighted level indicates significant noise in the middle range of frequencies.

**Nuisance**

A legal definition of a noise that offends or upsets the receiver because it is occurring at the wrong time in the wrong place or is of a character that annoys due to excessive tonal components or impulses.

**Occupational deafness**

The reduction in hearing acuity caused by excessive exposure to high noise levels at work. This is in addition to recreational noise exposure caused by factors outside of the workplace which may be additive.

**Occupational exposure limits**

8 hour time weighted average levels for each material under consideration. Limits are published by such bodies as OSHA, HSE etc. in each country.

**Occupational exposure standards**

These are standards applied to all materials and, in general, exposures below the standard would be regarded as demonstrating adequate compliance with the relevant statutory requirements.

**Occupational hygiene**

The science associated with the anticipation and recognition of workplace hazards and the evaluation and control of subsequent risks to health.

**Octave**

An interval between two sounds having a ratio of two to one in terms of their frequency span. There are 8 octaves on a piano and the audio range can be covered by 10 octaves in the range 20 Hz to 20 kHz.

**Octave band**

A single band of frequencies where the upper limit is twice the lower limit. Octave bands are classified according to their geometric center frequency based on the internationally standardized 1000 starting point. The 1000 Hz or 1 kHz band has limits of about 707 and 1414 Hz.

**Octave band analysis**

The analysis of a complex or simple sound into its constituent parts based on the interval of octave bands across the audio range. A full octave band analysis will contain 9 or 10 readings from 32 Hz to 8 kHz or 16 kHz.

**Octave band level**

The sound pressure level usually integrated over a time interval containing only the sounds with frequency components within the pass band of each octave band filter.

**Organic**

This means a substance that is carbon based.

**Oscillation**

A simple vibration that varies with time alternatively increasing and decreasing sound pressure at a receiver position due to the movement of an object.

**OSHA**

The Occupational Safety and Health Administration in the United States. A division of the Department of Labor charged with dealing with the health and welfare of the working population that issues guidelines and legislation to control the hazards at work.

**Outer ear**

The only visible part of the human hearing mechanism consisting of the pinna, or ear lobe. The purpose of the pinna is to direct the sound down the ear canal to the eardrum and the interface to the middle ear when the sound waves are converted to mechanical vibrations of the tympanic membrane.

**Overall noise level**

The total broadband noise level containing all the frequencies that are present in the sound. This is usually expressed as the A weighted noise level in dB, but can also be a C weighted level for specific measurement purposes.

**Particulate**

Can be an aerosol, mist, fog, dust, fumes or smoke depending upon the source.

**Passive sampling**

Air sampling without the aid of a sampling pump typically employing diffusion tubes.

**Peak**

The absolute highest positive or negative pressure of a sound wave at a given point in time and space.

**Peak response**

This is one of the standard responses in a sound level meter (or dosimeter).

**Peak noise level**

The noise level measured with a sound level meter set to the peak response in dB usually with no frequency weighting, i.e. a linear peak, or with the C weighting, i.e. a C weighted peak level.

**Peak sound pressure level**

The maximum absolute value of the instantaneous sound pressure in a specific interval of time. In the case of a sine wave produced by a steady noise source such as an acoustic calibrator the peak sound pressure level is 1.4 times the rms pressure level. This is equivalent to the peak level being 3 dB higher than that rms steady level.

**PEL**

The Permitted Exposure Level of a hazardous substance is the amount that a worker can be exposed to for a standard 8 hour workday. For noise measurements the PEL is a time weighted average level of 90 dB according to the OSHA workplace noise regulations.



## **Percentile noise level**

The notional noise level in dB exceeded for a given percentage of the measurement duration. Usually expressed as LN% where n represents the percentile value from 0 to 100 %. The L0% is equivalent to the maximum noise level since it is the level exceeded for 0% of the time, i.e. no readings are higher than the L0%. The L100% is equivalent to the minimum noise level since it is the level exceeded for 100% of the time and so is exceeded all of the measurement time. The L10% is often taken as a measure of the noise produced by highway traffic while the L90% is often taken as the background noise level. The L50% is the mean sound pressure level but it is not the same as the time average level, which is the unit Leq.

## **Period**

The duration in time that it takes an oscillation to repeat itself. For example a frequency of 1 kHz repeats itself with a period of  $1/1000 = 0.001$  seconds. A period can also mean the shorter measurement interval during a long run such as a 10-minute period in an 8-hour day measurement at a specific monitoring site.

## **Permanent threshold shift**

A permanent decrease of the hearing acuity of the ear at a specific frequency as compared to a previously established reference level. The amount of permanent threshold shift is commonly expressed in decibels and is unrecoverable by the individual who will not regain his or her hearing even by halting any exposure to excessive noise levels. It is an irreversible condition of the inner ear caused by damage to the individual hair cells in the cochlea.

## **Personal noise dosimeter**

A small portable noise meter especially developed to be worn by an individual during the working day. Its purpose is to accumulate all the different noise exposure suffered by the individual whether it comes as steady noise exposure or whether it is in the form of sudden impulses of noise. The microphone is usually clipped to the collar close to the hearing zone and the body of the dosimeter is worn on the belt or in a pocket for safety. Some newer noise dosimeters have the microphones built-in to the body of the unit so there are no cable to get tangled or caught. Traditionally noise dosimeters readout the results in dose based on a percentage of the allowed daily maximum. More modern noise dosimeters also produce the results in dB form for the average level plus maximum and minimum levels.

## **Personal noise exposure**

Noise exposure in the workplace that can affect a worker's hearing detrimentally over extended periods of exposure at high noise levels. Regulations exist in most industrialized countries to limit the danger to worker's hearing from such high levels of noise.

## **Personal protection**

Protection worn by an individual against an anticipated hazard at work. Possible examples include hard hats, boots with steel tips, ear plugs, ear muffs etc.

## **Personal sampling**

Occupational sampling of airborne contaminants in particulate form with sampling equipment worn by the operator. Measurements are normally taken in the breathing zone of the operator.

## **Personal sampling pump**

A small battery operated device worn by a worker that draws air at a constant rate across a filter mounted in a cassette. By keeping the flow rate constant a known volume of air is sampled in a given time interval. For example, at 2 l/m flow rate a sampling pump will pull through 120 liters of

air in 1 hour. The particulates in the air will be collected on the filter in the cassette and can be weighed at the end of the measurement to give a concentration in mg/m<sup>3</sup>.

## **Phon**

The logarithmic unit of measurement of the loudness level of a sound.

## **Pink noise**

Noise with a constant energy per octave (or third octave) bandwidth. A spectrum analysis of a pink noise source with a real time octave (or third octave) band analyzer would reveal a flat response across the frequencies of interest. Pink noise is often used as a stimulus signal in measurements of the characteristics of buildings and rooms since it produces equal energy across the whole audio bandwidth.

## **Pitch**

The attribute of auditory sensation that orders sounds on a scale extending from low to high. Pitch depends primarily on the frequency of the sound stimulus, but it also depends on the sound pressure and waveform of the stimulus.

## **Plane wave**

A sound wave whose wave fronts are parallel and perpendicular to the direction of propagation that the wave is traveling in.

## **PM2.5**

Particulate matter having a mean aerodynamic diameter of 2.5 microns usually related to ambient air monitoring.

## **PM10**

Particulate matter having a mean aerodynamic diameter of 10 microns usually related to ambient air monitoring.

## **Preamplifier**

An electrical device that acts as the interface between the microphone (or accelerometer) on a sound level meter (or vibration meter) that is used to match the high impedance of the transducer to the following electrical circuits of the measuring instrument. The preamplifier comes before any extension cable, where the microphone is remotely mounted from the meter, to prevent any significant signal loss down the extension cable caused by capacitive effects. Some preamplifiers are equipped with heater elements to minimize the harmful effects of moisture around the microphone capsule.

## **Precision**

An indication of the uniformity or reproducibility of a result of a physical measurement. Precision relates to the quality of an operation by which a measurement result is obtained, and is distinguished from accuracy, which relates to the quality of the result itself. Thus a measurement can have good precision in that repeated results will all be close together but still be inaccurate if they differ from the "true" result by some offset value or bias.

## **Presbycusis**

The reduction in human hearing acuity that is attributed simply to the normal aging process. This will occur irrespective of any exposure to high noise levels in the workplace.

## **Pressure drop**

The differential pressure drop across a restriction, such as a sample filter in a cassette, normally measured in inches (or cm) of water.

## **Probability**

A distribution of samples of the instantaneous noise level taken at regular intervals during a measurement where the samples are arranged according to their percentage of occurrence. The distribution ranges from 0% to a maximum % as the dynamic range increases. Each sample is allocated a place in the distribution according to its sampled level.

## **Probability distribution level**

The distribution of noise samples across the dynamic range of an instrument arranged at regular class widths such as every 0.5 dB. For an instrument with a 70 dB dynamic range there will be 143 class widths if the sampling is carried out at 0.5 dB steps. This will include an under and over range bin. The total number of samples to produce the percentage probability level divides the number of samples in each bin. For a random noise the distribution will have a Gaussian distribution.

## **Projected noise dose (Proj%)**

This is the projection of the actual measured noise dose to what it would be if the measurement were to continue for a full 8 hours. This value is usually used to predict what the eventual outcome would be at the end of a standard working day when a representative period of time has been used to carry out the measurement. If the actual measurement lasted for 1 hour 30 minutes, and a measured noise dose was found to be 27% then the 8 hour projected value would be calculated as  $27(8/1.5) = 144\%$ .

## **PUF filters (PolyUrethane Foam)**

Small cylindrical foam filters that can be inserted into the air stream when performing air sampling to limit the size of the average particles reaching the cassette or passing through an optical system. Different sized foams are available to provide different cut values depending on the purpose required for the measurement. Typical pore sizes for the PUF filter foams are 10, 4 and 2.5 microns. A size selective adaptor will be required to hold the PUF filter in place.

## **Pure tone**

A sound for which the sound pressure is a simple sinusoidal function of time, and characterized by a singleness of pitch (or frequency). Such examples are acoustic calibrators that generate a pure tone as the reference level.

## **Purge**

To keep an air sampling system clean and monitoring correctly by providing a supply of clean air across the optical lenses to prevent contamination. If the lenses become contaminated the system will under read the true concentration levels encountered during the run.

## Q factor

TWA Equal noise exposure risk combinations for different exchange rate "Q"

dB(A)	Q = 3	Q = 4	Q = 5
100	48 mn	1.41 hr	2 hr
99	1 hr	2.82 hr	
98		2 hr	
97			
96	2 hr		
95			4 hr
94		4 hr	
93	4 hr		
92			
91			
90	8 hr	8 hr	8 hr
89			
88			
87	16 hr		
86		16 hr	
85			16 hr

The number of decibels considered to double (or half) the risk of hearing damage in the workplace. A Q factor of 3 dB represents the equal energy principle and is based on the measured Leq value. A Q factor of 3 is recommended by certain US bodies such as NIOSH and the ACGIH and is mandated in European style noise regulations. A Q factor of 4 dB is mandated in certain US Department of Defense noise exposure regulations. The US OSHA regulations require a Q factor (or doubling rate) of 5 dB such that a noise is considered to be twice as risky (for the same exposure time) if it increases by 5 dB. The table above shows equal noise exposures for the main Q factor and noise level combinations.

### Random noise

An oscillation whose instantaneous magnitude is not specified for any given instant of time. It can be described statistically by the probability distribution function giving the fraction of the total time that the magnitude of the noise lies within a specified range.

### Real time analysis

The process of analyzing the frequency components of a complex sound into octave or third octave bands when all of the band levels are obtained at the same time. This is sometimes referred to as simultaneous frequency analysis and is a feature usually found on the more sophisticated models in a manufacturer's range of instruments due to the complexity of the signal processing involved. This type of analysis is required for the correct determination of transient sounds such as aircraft

flyovers or impulsive signals from blasts. Since all of the bands are calculated simultaneously no energy is lost or missed when performing this type of analysis.

## **Reflection**

The return of a sound wave from a hard surface. Also the scattering of a light wave by a dust particle in the air from its original straight path through the medium.

## **Refraction**

The bending of a sound wave or light wave from its original path, either because it is passing from one medium to another or by changes in the physical properties of the medium. Examples of this are temperature or wind gradients in the atmosphere.

## **Relative humidity**

The amount of water vapor in the air at any given time is usually less than that required to fully saturate the air. The relative humidity is the percentage of the saturation humidity, generally calculated in relation to saturated vapor density and expressed as a percentage figure. When air temperature and dew point temperatures are very close, the air is said to have a high relative humidity. This unit is usually abbreviated to RH%.

## **Resonance**

The relatively large amplitude of sound (or vibration) when the frequency of some source of sound matches the natural frequency of some object or component of the system.

## **Resonator**

A device that responds or resounds in sympathy with a source of sound or vibration.

## **Respirable**

The mass fraction of particles with a mean diameter of less than 4 microns.

## **Reverberant field**

The region in an enclosed space or room where the reflected sound dominates, as opposed to the region close to the noise source where the direct sound dominates.

## **Reverberation**

The persistence of a sound in an enclosed space as a result of multiple reflections after the source of the noise has stopped.

## **Reverberant room**

A specially designed room having a long reverberation time, usually used to make the sound field inside it as diffuse as possible. The walls are usually constructed from hard material such as smoothly plastered concrete blocks and the opposing walls are made non-parallel to prevent the buildup of standing waves with the space.

## **Reverberation Time (RT60)**

The reverberation time of a room is the time taken for the sound to decay by 60 dB from its steady state value when the source of the sound energy is suddenly stopped. It is a measure of the persistence of an impulsive sound in a room as well as the amount of acoustical absorption present inside the room. Rooms with long reverberation times are said to be "live" rooms while rooms with short RT's are said to be "dead" rooms. If a room has an RT that is too long, speech will be difficult to follow and absorption material may have to be placed in the room to reduce the RT value to acceptable limits.

**RMS. Sound pressure**

The root mean square (rms) value of a time varying signal is obtained by squaring the function at each instant, obtaining the average of the squared values over the interval of interest, and then taking the square root of the average value. The purpose of this is to convert an a.c. waveform into its equivalent d.c. value such that the variations can be read on a sound-measuring instrument. The rms value represents the effective energy value and is the best measure of steady continuous sounds. The period of interest, or averaging time, in sound measuring instruments is sometimes called the time weighting and is standardized in international regulations to specific values called the Slow, Fast and Impulse responses.

**RMS. level**

The rms level is the slowly varying sound level in decibels read from the display of a sound level meter (or other equivalent device) that shows the instantaneous sound pressure level with a selected time weighting applied to the signal. This is usually referred to as the Slow or Fast sound pressure level depending upon the selection of the time weighting in the instrument.

**Rotameter**

Same as a flow meter for verifying the flow rate of a sampling pump.

**Run**

The complete measurement process from the start time to the stop time encompassing all of the noise during that interval. A run can have just a single value attributed to the total noise level or it can be comprised of a number of regular shorter intervals that show how the noise level changed over time.

**Sabin**

A measure of the sound absorption of a surface. It is equivalent to a unit area of perfectly absorbing material.

**Sampling bag**

Used to collect gases and vapors during a measurement. Air is passed through the pump and enters an inert bag where it is collected for later analysis.

**Sampling conventions**

The size convention of particulate varies and is classified by how far they can travel within the breathing system of humans. Particles are classified by the D50 (or the 50th percentile of a distribution) as shown in the above family of aerodynamic diameters.

**Sensor**

A transducer that responds to changes in a certain condition, for example a thermometer that responds to changes in temperature.

**Sequential frequency analysis**

The process of carrying out a frequency analysis of a sound in which the component octave or third octave bands are determined using a single filter and scanning across the range of frequencies of interest. At the lower frequency bands more time will be required to allow the energy in the filter band to stabilize. As the analysis proceeds through the frequency bands the noise level will stabilize much quicker since a wider and wider range of frequencies are being included. Some sound analyzers will perform the scan under automatic control governed by the instrument in order to minimize the time needed to obtain a statistically reliable answer in every band. Carrying out third octave band sequential analysis will take longer than for an octave band analysis since more bands are involved. The noise source must be stationary during the sequential

analysis so this type of measurement technique is best suited to noise sources that are continuous such as fan or pump noise.

### **Shielding**

The attenuation of a sound that is achieved by placing barriers in between the source and the receiver.

### **Short term exposure limit STEL**

A 15 minute short term exposure limit rather like a TWA. If no STEL is quoted for a substance then a level 3 times the 8 hour TWA may be assumed but the total duration of the excursions should not exceed one hour in any 24 hour period.

### **Sick building syndrome**

A widespread occupational health concern that is commonly associated with air conditioning systems in buildings. Symptoms vary but will normally include irritated eyes, nose and throat, headaches and lethargy.

### **Silicosis**

A lung disease caused by excessive inhalation of crystalline silica dust.

### **Size selective adaptor**

This is an adaptor for an air sampling system that allows dust particles of a certain size to be filtered out before arriving on the cassette or passing through the optical measurement system.

### **Slow response**

This is one of the standard responses in a sound level meter (or dosimeter).

### **Slow weighting**

The slow weighting is the same as the slow response in a sound level meter and is part of the rms. circuit controlling the response of the meter to the variability of the instantaneous levels of the noise. It has a value of 1000 milli seconds (1 second) and is a continuous function that is calculated all the time by the instrument.

### **Sociocosis**

The loss of hearing caused by noise exposures that are part of everyday social life, exclusive of any occupational noise exposure, physiological changes with age or disease.

### **Sone**

The loss of hearing caused by noise exposures that are part of everyday social life, exclusive of any occupational noise exposure, physiological changes with age or disease.

### **Sorbent tubes**

Small tubes used to absorb sample gases and vapors. Contain one or more layers of sorbent material whose type depends on the gas/vapor to be sampled. Air to be sampled is drawn through the tube trapping the airborne chemicals. The tube can then be analyzed in a laboratory to determine what substances are present in the sample.

### **Sound**

An oscillation in air pressure in an elastic medium. It is also an auditory sensation evoked by these oscillations. Not all sound waves will evoke an auditory response, for example, ultrasonic waves.

### **Sound exposure level (SEL, LAE)**

The total noise energy in an event expressed as if it had only lasted for a single 1 second duration at the notional level in dB that contains the same amount of noise energy as the actual noise

event. Measurement of the sound exposure levels of different noise sources allows their contribution to the overall noise climate to be easily compared since all results are referenced to the same time interval of 1 second.

## **Sound level**

The frequency and time weighted sound pressure obtained by the use of a sound level meter (or other equivalent device) as specified by the relevant ANSI standards for sound level meters. The level is expressed in decibels relative to the reference pressure level and unless specified to the contrary is normally taken to be the A weighted level.

## **Sound level meter**

A measuring instrument comprising a transducer (the microphone), a frequency weighting circuit (the A, B or C responses), an rms circuit (the slow, fast or impulse weighting) some data processing (the microprocessor, if fitted) and an output device (the analog needle display or digital LCD) for the accurate measurement of noise and sound. Sound level meters can be battery operated for field use or can be powered from external power sources depending upon their power consumption and the length of time required for autonomous operation.

## **Sound power**

The inherent quantity of a sound source irrespective of its local position in the environment. It is the total sound energy radiated by a noise source in unit time. The unit of sound power is the watt.

## **Sound power level**

Ten times the logarithm to the base 10 of the actual weighted sound power to the reference sound power. The reference sound power is taken to be 1  $\mu$ W (or 0.000,001 Watt). This result is a logarithmic quantity called the decibel or dB.

## **Sound pressure**

The instantaneous difference between the actual pressure produced by a sound wave and the current atmospheric barometric air pressure at a given point in space.

## **Sound pressure level**

Twenty times the logarithm to the base 10 of the actual weighted sound pressure to the reference sound pressure. The reference sound pressure is taken to be 20  $\mu$ Pa (or 0.000,020 Pa). This result is a logarithmic quantity called the decibel or dB.

## **Sound quality**

The objective measurement of sounds perceived by a listener that involve more than just the simple overall level of noise. Frequency content is very important and is often measured with a real time third octave band analyzer.

## **Sound transmission**

The study of the passage of sound through structures to determine the effectiveness of the insulation of different materials used for the construction of walls, floors ceilings etc.

## **Sound transmission class**

The preferred single figure rating system designed to give an estimate of the sound insulation properties of a structure or a rank ordering of a series of structures.



**Sound transmission loss**

A measure of the sound insulation provided by a structure of specific design and construction. Expressed in dB, it is 10 times the logarithm to the base 10 of the reciprocal of the sound transmission coefficient of the configuration.

**Span**

The range of measurement capability in a monitoring instrument from the smallest to the largest value. Sometimes called the dynamic range.

**Spectrum**

The description of a sound wave's resolution into its components of frequency and amplitude.

**Spectrum analysis**

The measurement and determination of the contribution of the various frequencies that go to make up the overall sound level measured with a sound level meter.

**Speech interference level**

A calculated quantity providing a guide to the interference of a noise with the reception of speech. The speech interference level is the average of the octave band levels of the interfering noise in the most important part of the spectrum. The levels in the 500, 1000 and 2000 Hz bands are averaged together to give the speech interference level in dB.

**Speed of sound**

Sound waves travel through different media at different speeds depending upon the composition of the material. For sound waves traveling in air at normal temperature (21°C, 70°F) and pressure (1013 mB) the speed of sound is 344 m/s (1128 f/s). sound waves traveling through steel have a faster speed of transmission.

**Spherical wave**

A sound wave in which the surfaces of constant phase are concentric spheres. A small point source radiating into an open space produces a free sound field of spherical waves.

**Stack monitoring**

The characterization and quantification of emission parameters and components discharged from point (chimney) emission sources.

**Standing waves**

The condition within enclosed spaces, such as rooms, in which sound reflects off opposing surfaces, such as the floor and ceiling, and produces noticeable "hot spots" of higher energy sound. The effect is frequency dependant and highs and lows of sound will occur at integer multiples of half wavelengths as the waves add or cancel out in the space between the reflective surfaces.

**Static monitoring**

Monitoring at a fixed location.

**Statistical analysis**

The classification of the magnitudes of a measured parameter into a cumulative frequency distribution from which various statistical levels can be derived.

**Statistical noise levels**

The calculated noise level based on sampling the varying noise climate and expressing the result as a percentage of time above the chosen statistical level. For example, the LN10% is the noise level exceeded for 10% of the measured time interval. The samples of the noise are sorted into a

distribution table at fixed dB intervals and the statistics are calculated from the cumulative distribution curve that is produced. In a 10 minute measurement the LN10% value represents the level of noise exceeded for 1 minute in total. The noise does not have to be continuously above the calculated statistical level but the sum of the times when it is will give the statistical value required.

### **Steady noise**

Noise that remains constant within a typical limit of  $\pm 2$  dB and without large fluctuations over extended periods of time.

### **Steady state noise**

Sounds whose average characteristics remain relatively constant over time. Typical examples of steady state noises are fans, air conditioning units and compressors or pumps.

### **Tape recorder**

A mechanical recording device utilizing a medium such as audiotape to store the original ac-varying signal from the microphone output of a sound level meter. Tape recorders can use reel-to-reel open tapes of various sizes or can be of the closed types such as a DAT (Digital Audio Tape) cassette of a certain size. The audiotape can be used to verify the source of a nuisance noise or for archiving purposes to show before and after sound quality.

### **Telemetry**

The transmission of data sets from a remote monitoring device over large distances to a central readout location. Can be done by radio signals or by telephone modems.

### **Temporary threshold shift**

A temporary impairment of hearing acuity as indicated by a change in the threshold of audibility.

### **Third octave band**

A frequency band whose cutoff frequencies have a ratio of 2 to the third power (about 1.25). the third octave band centered at 1000 Hz has a lower cutoff frequency of 891 Hz and a higher cutoff frequency of 1112 Hz. These are the frequencies at which the response of the filter has dropped to half, sometimes called the 3dB down points.

### **Third octave band analysis**

The process of performing a frequency analysis of a noise by breaking up the sound into a series of contiguous bands whose bandwidth is a third of an octave. 31 third octave frequency bands cover the typical audio range from 20 Hz to 20 kHz.

### **Thoracic fraction**

The mass fraction of inhalable particles penetrating beyond the larynx. Typically this will represent particles with a mean aerodynamic diameter of less than 10 microns.

### **Threshold level**

The sound level in dB below which an instrument will ignore any quieter noise levels for the purpose of measuring a noise dose in the workplace. Typical threshold levels are 80 and 90 dB used in personal noise dosimeters to comply with workplace noise measurement techniques specified by the OSHA regulations. Sometimes it is also called the cutoff level.

### **Threshold of audibility**

The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of tests carried out in acoustically controlled conditions.

**Threshold of pain**

The minimum sound pressure level of sound outside the ear that will produce a change from discomfort to definite pain. Typically taken to be at about a level of 130 A weighted dB.

**Threshold shift**

A change in the threshold of audibility at a specified frequency from a threshold previously established for that individual. The amount of the threshold shift is normally expressed as a dB value.

**Timbre**

An attribute of auditory sensation allowing a subject to judge that two sounds similarly presented and having the same loudness and pitch are dissimilar. Effectively, the ability of an individual to be able to tell the difference between the two sounds even though they both appear to be equally as loud and of the same pitch.

**Time**

One of the three fundamental variables of noise measurement along with amplitude and frequency.

**Time history**

The resultant set of values produced by an instrument to record (or data log) the changing noise levels during a run. The measured changes indicate the time history variations of the noise.

**Time history profile**

The regular short values of certain levels of a parameter (such as noise or temperature) that are recorded during a measurement run to be able to visualize the temporal changes in that (noise or temperature) climate at a chosen time resolution.

**Time weighting**

Another name for the time response in the rms section of a sound level meter. The standard time weightings generally found in an instrument include the Slow, Fast and Impulse weightings.

**Time weighted average level**

Occupational exposure limits for a material or hazard expressed as an 8 hour time weighted average value (TWA) that includes the whole of the shift exposure. For noise it is a single number equivalent value in decibels that represents the equivalent average level of the actual changing noise levels. When the exchange rate is chosen as 3 dB the average noise level is called the Leq. When the exchange rate is chosen as 4 dB the average noise level is called the LDoD. When the exchange rate is chosen as 5 dB the average noise level is called the LOSHA. In the example above the blue line shows the minute by minute changing noise levels from 65 to 92 dB while the horizontal black line shows the equivalent TWA value at 80.9 dB.

**Tinnitus**

A ringing in the ears or noise sensed in the head. The onset may be due to an acoustic trauma and still persist in the absence of the stimulus. A person suffering from tinnitus will complain of being able to hear noises even in very quiet surroundings. This condition is very difficult to prove or to treat.

**Tone**

A sound with a definite pitch. A pure tone from a device like an acoustic calibrator will produce a sinusoidal waveform when viewed on a suitable display.

**Total inhalable fraction**

The mass fraction of total airborne particles that are inhaled through the mouth and nose.

**Transducer**

A device capable of being stimulated by waves from one or more transmission systems or media and supplying related waves to one or more other transmission systems or media. Typical examples are microphones that convert (or transduce) sound waves into an equivalent electrical signal or accelerometers that convert vibrations into useful electrical signals.

**Transmission loss (dB)**

The decibel reduction in noise level across a partition as measured in third octave bands. Usually measured with a real time frequency analyzer from 100 Hz to 3k15 Hz.

**Type 1**

A grade of overall accuracy taking into account the physical response of the complete measurement system that has tolerances in terms of frequency, direction, temperature, humidity, ambient air pressure etc. A sound measurement device having a claimed accuracy of type 1 according to ANSI (or other equivalent international standards) is sometimes called a precision instrument. Type 1 instruments are usually specified where the best accuracy is mandated.

**Type 2**

A grade of overall accuracy taking into account the physical response of the complete measurement system that has tolerances in terms of frequency, direction, temperature, humidity, ambient air pressure etc. A sound measurement device having a claimed accuracy of type 2 according to ANSI (or other equivalent international standards) is sometimes called a general-purpose instrument. Type 2 instruments are usually specified where the absolute accuracy is not critical or where cost is a compelling factor.

**Ultrasonic sound**

Sound waves with frequencies higher than 20 kHz beyond the audible range for a normal human being. Dog whistles operate at frequencies around the 30 kHz region. Bats are thought to be able to "hear" ultrasonic sounds up to about 100 kHz.

**Vapor**

A liquid or moisture diffused or suspended in air.

**Variable noise**

Noise levels that change gradually with time and are not constant or steady. Variations might be as large as 10 dB about an "eyeball" averaged notional steady value.

**Vibration**

An oscillatory motion of solid bodies described by displacement, velocity and acceleration with respect to a fixed reference position. The movement of a body can cause vibrations to be produced that can be transmitted as unwanted sound waves.

**Vibration isolation**

The process reducing the amount of motion passed through a system by the introduction of suitable materials.

**Vibration isolator**

A material specifically designed to reduce the level of vibration transmitted from one part of a structure to another part. Springs can be used to isolate vibrations from one part of a machine from another part.

**VOC**

Volatile organic compound. Examples of VOC's are isobutylene and other hydrocarbons.

**Volatile**

This means a substance is easily converted into a vapor.

**Wave**

A disturbance that travels through a medium such as air by virtue of the elastic properties of that medium.

**Wavelength**

When considering periodic waves (such as the passage of sound in air) it is the distance between similar points on any two successive wave fronts.

**Wavelength of sound**

The wavelength of a sound is inversely proportional to the frequency of that sound such that the lower the frequency, the longer the wavelength of that sound will be. The wavelength and the frequency of a noise are related by the speed of sound in air. For sound waves in air the typical wavelength of a 1 kHz tone is 34.4 cm (about 13.5 in). A low pitch sound such as the frequency of the electrical transmission system at 60 Hz the equivalent wavelength is 225 ft (5.73 m). All figures are based on standard temperature and pressure. For light the wavelengths are usually expressed in nanometers (nm or 10<sup>-9</sup>m).

**WBGT**

$$\text{WBGT}(\text{indoor}) = 0.7 \text{ t}_{\text{nw}} + 0.3 \text{ t}_{\text{g}}$$

$$\text{WBGT}(\text{outdoor}) = 0.7 \text{ t}_{\text{nw}} + 0.2 \text{ t}_{\text{g}} + 0.1 \text{ t}_{\text{a}}$$

The wet bulb globe temperature index is a means of specifying a measurable quantity to assess the risk of an operator suffering from heat stroke or other symptoms when working in hot areas. It is an empirical index based upon the relationship between the three different temperatures recorded by thermometers that measure the temperatures of the dry air, the globe and the natural wet bulb in the area where people are working. Corrections are applied depending upon the clothing and work rates to arrive at a safe WBGT temperature for indoors and outdoors.

**Weighting**

An internationally prescribed frequency filter shape provided in sound measuring devices such as sound level meters to try and characterize the overall effect of certain sounds on a typical listener.

**Wet bulb thermometer**

The temperature reported by a thermometer that has a wetted wick around it to measure the naturally aspirated temperature for WBGT measurements.

**White noise**

Sound or noise whose energy is uniformly distributed over a wide range of frequencies such that there is constant energy per Hertz. When measured with an octave or third octave band filter set the spectrum of a white noise source will be seen to drop off at 3 dB per octave as the frequency increases.

## **Wind chill**

The additional cooling effect of wind that makes the temperature feel lower than that actually measured by a thermometer in still air. The temperature is still the same as in still air but it just feels colder because the body's heat is lost more quickly.

## **Windscreen**

A foam ball fitted over the microphone of a sound level meter to reduce the effects of wind induced noise on the readings being carried out. Windscreens are often manufactured from open cell design foams to allow free passage to the sounds of interest without unduly affecting the frequency response of the system beyond acceptable limits. Foam windscreens should always be used when performing outdoor measurements but will not be effective if allowed to become waterlogged or when used in high wind speeds in excess about 30 f/s (or 10 m/s, ~ 20 mph).

## **X rays**

Part of the electromagnetic spectrum that has a much higher frequency than normal audio or optical waves.

## **Z weighting**

One of the standard frequency correction curves (or weightings) applied to sounds in a measurement device to simulate the hearing capability of the human hearing mechanism. The Z weighting is most often used for the measurement of octave band noise levels. The Z weighting response is specified in newer acoustic standards since it has a defined characteristic unlike the linear (or un-weighted) frequency weighting found in earlier noise meters.

## **Zoning requirements**

Defining areas of a town or city into different regions where only certain activities are allowed. Examples include residential, commercial, industrial zones that will often have different rules for exposure to noise levels considered to constitute a nuisance.