

# Noise Control Terms Made Somewhat Easier

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This dictionary of terms related to noise and noise control is a useful tool for those who are investigating how to reduce the amount of noise pollution in their environment.

## Introduction

Trying to communicate is difficult enough even when we have clear and sharp definitions of all the words we exchange. Scientists, in their extreme pursuit of accuracy, are known to burden their communications with endless qualifiers rendering comprehension impossible.

The authors have felt, for some time, the need to compile a glossary of technical terms commonly used in the field of noise control. To achieve this goal we borrowed freely from many sources. Those we consciously remember are listed in the Bibliography and to the authors we express our deepest thanks.

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## Dictionary

**ABSORPTION.** A property of materials that allows a reduction in the amount of sound energy reflected. The introduction of an absorbent into the surfaces of a room will reduce

the sound pressure level in that room by not reflecting all of the sound energy striking the room's surfaces. The effect of absorption merely reduces the resultant sound level in the room produced by energy that has already entered the room.

**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. Unless otherwise specified, a diffuse sound field is assumed. The values at the sound-absorption coefficient usually range from about 0.01 for marble slate to almost 1.0 for long absorbing wedges often used in anechoic rooms.

**ACOUSTICS.** (1) The science of sound, including the generation, transmission, and effects of sound waves, both audible and inaudible. (2) The physical qualities of a room or other enclosure (such as size, shape, amount of noise) that determine the audibility and perception of speech and music within the room.

**ACOUSTIC TRAUMA.** Damage to the hearing mechanism caused by a sudden burst of intense noise, or by a blast. The term usually implies a single traumatic event.

**AIRBORNE SOUND.** Sound that reaches the point of interest by propagation through air.

**AMBIENT NOISE.** The total of all noise in the environment, other than the noise from the source of interest. This term is used interchangeably with background noise.

**ANECHOIC ROOM.** A room in which the boundaries absorb nearly all the incident sound, thereby, effectively creating free field conditions.

**ANSI.** The American National Standards Institute.

**ARTICULATION INDEX (AI).** A numerically calculated measure of the intelligibility of transmitted or processed speech. It takes into account the limitations of the transmission path and the background noise. The ar-

tication index can range in magnitude between 0 and 1.0. If the AI is less than 0.1, speech intelligibility is generally low. If it is above 0.6, speech intelligibility is generally high.

**ATTENUATION.** The reduction of sound intensity by various means (e.g., air, humidity, porous materials...).

**(AUDIO-FREQUENCY RANGE).** The frequency range 16 Hz to 20,000 Hz (20 kHz). Note.- This is conventionally taken to be the normal frequency range of human hearing.

**AUDIO FREQUENCY.** The frequency of oscillation of an audible sound wave. Any frequency between 20 and 20,000 Hz.

**AUDIOGRAM.** A graph showing individual hearing acuity as a function of frequency.

**AUDIOMETER.** An instrument for measuring individual hearing acuity.

**AUDIOMETRY.** The measurement of hearing.

**A-WEIGHTED SOUND LEVEL.** A measure of sound pressure level designed to reflect the acuity of the human ear, which does not respond equally to all frequencies. The ear is less efficient at low and high frequencies than at medium or speech-range frequencies. Therefore, to describe a sound containing a wide range of frequencies in a manner representative of the ear's response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the noise level. Sound level meters have an A-weighting network for measuring A-weighted sound level.

**BACKGROUND NOISE.** The total of all noise in a system or situation, independent of the presence of the desired signal. In acoustical measurements, strictly speaking, the term "background noise" means electrical noise in the measurement system. However, in popular

usage the term "background noise" is often used to mean the noise in the environment, other than the noise from the source of interest.

**BAND.** Any segment of the frequency spectrum.

**BAND PASS FILTER.** A wave filter that has a single transmission band extending from a lower cutoff frequency greater than zero to a finite upper cutoff frequency.

**BROADBAND NOISE.** Noise with components over a wide range of frequencies.

**CALIBRATOR (ACOUSTICAL).** A device which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to Standard specifications.

**COCHLEA.** A spirally coiled organ located within the inner ear which contains the receptor organs essential to hearing.

**CONTINUOUS NOISE.** On-going noise whose intensity remains at a measurable level (which may vary) without interruption over an indefinite period or a specified period of time.

**CUTOFF FREQUENCIES.** The frequencies that mark the ends of a band, or the points at which the characteristics of a filter change from pass to no-pass.

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

**CYCLES PER SECOND.** A measure of frequency numerically equivalent to hertz.

**CYLINDRICAL WAVE.** A wave in which the surfaces of constant phase are coaxial cylinders. A line of closely-spaced sound sources radiating into an open space produces a free sound field of cylindrical waves.

**DAMPING.** The dissipation of energy with

time or distance. The term is generally 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.

**dB<sub>A</sub>.** Unit of sound level. The weighted sound pressure level by the use of the A metering characteristic and weighting specified in ANSI Specifications for Sound Level Meter, S1.4-1983. dB<sub>A</sub> is used as a measure of human response to sound.

**DEAFNESS.** 100 percent impairment of hearing associated with an organic condition. This is defined for medical and cognate purposes as the hearing threshold level for speech or the average hearing threshold level for pure tones of 500, 1000 and 2000 Hz in excess of 92 dB.

**DECIBEL.** A unit of sound pressure level, abbreviated dB.

**DIFFRACTION.** A modification which soundwaves undergo in passing by the edges of solid bodies.

**DIRECTIVITY INDEX.** In a given direction from a sound source, the difference in decibels between (a) the sound pressure level produced by the source in that direction, and (b) the space-average sound pressure level of that source, measured at the same distance.

**DOPPLER EFFECT (DOPPLER SHIFT).** The apparent upward shift in frequency of a sound as a noise source approaches the listener or the apparent downward shift when the noise source recedes. The classic example is the change in pitch of a railroad whistle as the locomotive approaches and passes by.

**DOSIMETER.** A device worn by a worker for determining the worker's accumulated noise exposure with regard to level and time according to a pre-determined integration formula.

**ECHO.** A wave that has been reflected or otherwise returned with sufficient magnitude and delay, so as to be detected as a wave distinct from that directly transmitted.

**ENVIRONMENTAL NOISE.** The intensity, duration, and character of sounds from all sources.

**EQUIVALENT A-WEIGHTED SOUND LEVEL (Leq).** The constant sound level that, in a given time period, would convey the same sound energy as the actual time-varying A-weighted sound level.

**FAR FIELD.** Describes a sound source region in free space where the sound pressure level obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). Also, in this region the sound particle velocity is in phase with the sound pressure. Closer to the source where these two conditions do not hold constitutes the "near field" region.

**FILTER.** A device for separating components of a signal on the basis of their frequency. It allows components in one or more frequency bands to pass relatively unattenuated, and it attenuates components in other frequency bands.

**FREE SOUND FIELD (FREE FIELD).** A sound field in which the effects of obstacles or boundaries on sound propagated in that field are negligible.

**FREQUENCY.** The number of times per second that the sine wave of sound repeats itself, or that the sine wave of a vibrating object repeats itself. Now expressed in hertz (Hz), formerly in cycles per second (cps).

**HAIR CELL.** Sensory cells in the cochlea which transform the mechanical energy of sound into nerve impulses.

**HARMONIC.** A sinusoidal (pure-tone) component whose frequency is a whole-number

multiple of the fundamental frequency of the wave. If a component has a frequency twice that of the fundamental it is called the second harmonic, etc...

**HEARING.** The subjective human response to sound.

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

**HEARING LOSS.** A term denoting an impairment of auditory acuity. The amount of hearing impairment, in decibels, measured as a set of hearing threshold levels at specified frequencies. Types of hearing loss are: 1. Conductive: A loss originating in the conductive mechanism of the ear; 2. Sensor-neural: A loss originating in the cochlea or the fibers of the auditory nerve; 3. Noise induced: A sensor-neural loss attributed to the effects of noise.

**HEARING THRESHOLD LEVEL (HTL).** Amount (in decibels) by which an individual's threshold of audibility differs from a standard audiometric threshold.

**HERTZ (Hz).** Unit of measurement of frequency, numerically equal to cycles per second

**IMPACT INSULATION CLASS (IC).** 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 solid objects. Typical sources are footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building.

**IMPULSIVE NOISE,** a) Either a single sound pressure peak (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) or multiple sound

pressure peaks (with either rise time less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 200 millisecond pauses, b) A sharp sound pressure peak occurring in a short interval of time.

**INFRASONIC.** Sounds of a frequency lower than 20 hertz.

**INTENSITY.** The sound energy flow through a unit area in a unit time.

**INTERMITTENT NOISE.** Fluctuating noise whose level falls once or more times to low or unmeasurable values during an exposure. In this document intermittent noise will mean noise that is below 65 dBA at least 10% of any 1 hour period.

**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 occurs in free field situations, where the sound pressure level decreases 6 dB with each doubling of distance from the source.

**ISO.** The International Organization for Standardization.

**LEVEL.** The logarithm of the ratio of a quantity to a reference quantity of the same kind. The base of the logarithm, the reference quantity, and the kind of level must be specified.

**LOGARITHM.** The exponent that indicates the power to which a number must be raised to produce a given number. For example, for the base 10 logarithm, used in acoustics, 2 is the logarithm of 100.

**LOUDNESS.** The subjective judgment of intensity of a sound by humans. Loudness depends upon the sound pressure and frequency of the stimulus. Over much of the frequency range it takes about a threefold increase in sound pressure (a tenfold increase in acoustical energy, or, 10 dB) to produce a doubling of loudness.

**LOUDNESS LEVEL.** Measured in phons it is numerically equal to the median sound pressure level (dB) of a free progressive 1000 Hz wave presented to listeners facing the source, which in a number of trials is judged by the listeners to be equally loud.

**MASKING.** 1. The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound. 2. The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound.

**MASKING NOISE.** A noise that is intense enough to render inaudible or unintelligible another sound that is also present.

**MEDIUM.** A substance carrying a sound wave.

**NEAR FIELD.** The sound field very near to a source, where the sound pressure does not obey the inverse-square law and the particle velocity is not in phase with the sound pressure.

**NIOSH.** The National Institute for occupational Safety and Health.

**NOISE,** 1. Unwanted sound. 2. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources. 3. An erratic, intermittent, or statistically random oscillation.

**NOISE EXPOSURE.** The cumulative acoustic stimulation reaching the ear of the person over a specified period of time (e.g., a work shift, a day, a working life, or a lifetime).

**NOISE HAZARD (HAZARDOUS NOISE).** Acoustic stimulation of the ear which is likely to produce noise-induced permanent threshold shift in some of a population.

**NOISE-INDUCED PERMANENT THRESHOLD SHIFT (NIPTS).** Perma-

nent threshold shift caused by noise exposure, corrected for the effect of aging (presbycusis).

**NOISE-INDUCED TEMPORARY THRESHOLD SHIFT (NITTS).** Temporary threshold shift caused by noise exposure.

**NOISE ISOLATION CLASS. (NIC).** 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 airborne sound, unless specified to the contrary, it is the A-weighted sound level.

**NOISE REDUCTION (NR).** The numerical difference, in decibels, of the average sound pressure levels in two areas or rooms. A measurement of "noise reduction" combines the effect of the sound transmission loss performance of structures separating the two areas or rooms, plus the effect of acoustic absorption present in the receiving room.

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

**NON-IMPULSIVE NOISE.** all noise not included in the definition of impulsive noise.

**OCTAVE.** The interval between two sounds having a frequency ratio of two.- There are 8 octaves on the keyboard of a standard piano.

**OCTAVE BAND.** A segment of the frequency spectrum separated by an octave.

**OCTAVE BAND LEVEL.** The integrated sound pressure level of only those sine-wave components in a specified octave band.

**OSCILLATION.** The variation with time,

alternately increasing and decreasing, of (a) some feature of an audible sound, such as the sound pressure; or (b) some feature of a vibrating solid object, such as the displacement of its surface.

**OSHA.** The Occupational Safety and Health Administration.

**OTOLOGICALLY NORMAL.** Enjoying normal health and freedom from all clinical manifestations and' history of ear disease or injury; and having a patent (wax-free) external auditory meatus.

**PEAK SOUND PRESSURE.** The maximum absolute value of the instantaneous sound pressure in a specific time interval. Note: in the case of a periodic wave, if the time interval considered is a complete period, the peak sound pressure becomes identical with the maximum sound pressure.

**PERIOD.** The duration of time it takes for a periodic wave form (like a sine wave) to repeat itself.

**PERMANENT THRESHOLD SHIFT (PTS).** A permanent decrease of the acuity of the ear at a specified frequency as compared to a previously established reference level. The amount of permanent threshold shift is customarily expressed in decibels.

**PHON.** The unit of measurement for loudness level.

**PINK NOISE.** Noise with constant energy per octave band width.

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

**PLANE WAVE.** A wave whose wave fronts are parallel and perpendicular to the direction in which the wave is traveling.

**PRESBYCUSIS.** The decline in hearing acuity that is attributed to the aging process.

**PURE TONE.** A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch.

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

**REFLECTION.** The return of a sound wave from a surface.

**REFRACTION.** The bending of a sound 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, e.g., a temperature or wind gradient in the air.

**RESONANCE.** The relatively large amplitude of vibration produced when the frequency of some source of sound or vibration "matches" the natural frequency of vibration of some object, component, or system.

**RESONATOR.** A device that resounds or vibrates in sympathy with a source of sound or vibration.

**REVERBERANT FIELD.** The region in a 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 sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped.

**REVERBERATION ROOM.** A room hav-

ing a long reverberation time, especially designed to make the sound field inside it as diffuse (homogeneous) as possible.

**REVERBERATION TIME (RT).** The reverberation time of a room is the time taken for the sound pressure level to decrease 60 dB from its steady-state value when the source of sound energy is suddenly interrupted. It is a measure of the persistence of an impulsive sound in a room as well as of the amount of acoustical absorption present inside the room. Rooms with long reverberation times are called live rooms.

**RMS SOUND PRESSURE.** The square root of the time averaged square of the sound pressure.

**ROOT-MEAN-SQUARE (RMS).** 1. The root-mean-square value of a time-varying quantity 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 this average. For a sine wave, if you multiply the RMS value by the square root of 2, or about 1.41, you get the peak value of the wave. The RMS value, also called the effective value of the sound pressure, is the best measure of ordinary continuous sound, but the peak value is necessary for assessment of impulsive noises. 2. A term describing the mathematical process of determining an 'average' value of a complex signal.

**SABIN.** A measure of the sound absorption of a surface; it is the equivalent of one square foot of a perfectly absorptive surface.

**SHIELDING.** The attenuation of a sound, achieved by placing barriers between a sound source and the receiver

**SONE.** The unit of measurement for loudness. One sone is the loudness of a sound whose loudness level is 40 phons. Loudness is proportional to the sound's loudness rating, e.g., two sones are twice as loud as one sone.

**SOCIOCUSIS.** Loss of hearing caused by

noise exposures that are part of the social environment, exclusive of occupational-noise exposure, physiological changes with age, and disease.

**SOUND.** 1. An oscillation in pressure, stress, particle displacement, particle velocity, etc., in an elastic or partially elastic medium, or the superposition of such propagated alterations. 2. An auditory sensation evoked by the oscillation described above. Not all sound waves can evoke an auditory sensation: e.g. ultrasound.

**SOUND EXPOSURE LEVEL.** The level of sound accumulated over a given time interval or event. Technically, the sound exposure level is the level of the time-integrated mean square A-weighted sound for a stated time interval or event, with a reference time of one second.

**SOUND LEVEL.** The weighted sound pressure level obtained by the use of a sound level meter and frequency weighting network, such as A, B, or C as specified in ANSI specifications for sound level meters (ANSI S1.4-1971, or the latest approved revision). If the frequency weighting employed is not indicated, the A-weighting is implied.

**SOUND LEVEL METER.** An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

**SOUND POWER.** The total sound energy radiated by a source per unit time. The unit of measurement is the watt.

**SOUND PRESSURE.** The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

**SOUND PRESSURE LEVEL (SPL).** 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound

pressure level in units of decibels is expressed as SPL (dB) =  $20 \log p/pr$ .

### **SOUND TRANSMISSION CLASS**

**(STC).** 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 (STL).**

A measure of sound insulation provided by a structural configuration. Expressed in decibels, it is 10 times the logarithm to the base 10 of the reciprocal of the sound transmission coefficient of the configuration.

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

**SPEECH DISCRIMINATION.** The ability to distinguish and understand speech signals.

### **SPEECH-INTERFERENCE LEVEL**

**(SIL).** A calculated quantity providing a guide to the interference of a noise with the reception of speech. The speech-interference level is the arithmetic average of the octave band levels of the interfering noise in the most important part of the speech frequency range. The levels in octave bands centered at 500, 1000, and 2000 Hz are commonly averaged to determine the speech-interference level.

**SPEED (VELOCITY) OF SOUND IN AIR.** 344 m/sec (1128 ft/sec) at 70 degrees F in air

**SPHERICAL DIVERGENCE.** The condition of propagation of spherical waves that relates to the regular decrease in intensity of a spherical sound wave at progressively greater distances from the source. Under this condition the sound pressure level decreases 6 decibels with each doubling of distance from the source.

**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. .

**STEADY-STATE SOUNDS.** Sounds whose average characteristics remain relatively constant in time. A practical example of a steady-state sound source is an air conditioning unit.

### **TEMPORARY THRESHOLD SHIFT**

**(TTS).** 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 one-third power, which is approximately 1.26. The cutoff frequencies of 891 Hz and 1112 Hz define the 1000 Hz third-octave band in common use.

### **THRESHOLD OF AUDIBILITY**

**(THRESHOLD OF DETECTABILITY).** The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of trials.

**THRESHOLD OF PAIN.** The minimum sound pressure level of a sound outside the ear that will produce a transition from discomfort to definite pain.

**THRESHOLD SHIFT.** A change in the threshold of audibility at a specified frequency from a threshold previously established. The amount of threshold shift is customarily expressed in decibels.

**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, e.g., trumpet vs. violin.

**TINNITUS.** Ringing in the ear or noise sensed in the head. Onset may be due to an acoustic trauma and persist in the absence of

acoustical stimulation (in which case it may indicate a lesion of the auditory system).

**TONE.** A sound of definite pitch. A pure tone has a sinusoidal wave form.

**TRANSDUCER.** A device capable of being actuated by waves from one or more transmission systems or media and supplying related waves to one or more other transmission systems or media. Examples are microphones, accelerometers, and loudspeakers.

**ULTRASONIC.** Sounds or a frequency higher than 20,000 hertz.

**VIBRATION.** An oscillatory motion of solid bodies described by displacement, velocity, or acceleration with respect to a given reference point.

**VIBRATION ISOLATOR.** A resilient support for vibrating equipment designed to reduce the amount of vibration transmitted to the other structures.

**WAVE.** A disturbance that travels through a medium by virtue of the elastic properties of that medium.

**WAVELENGTH.** For a periodic wave (such as sound in air), the distance between analogous points on any two successive waves. The wavelength of sound in air or in water is inversely proportional to the frequency of the sound. Thus, the lower the frequency, the longer the wavelength.

**WEIGHTING.** Prescribed frequency filtering provided in a sound level meter.

**WHITE NOISE.** Noise whose energy is uniform over wide range of frequencies, being analogous in spectrum characteristics to white light.

**WINDSCREEN.** A porous device used to cover the microphone of a sound level measurement system which is designed to minimize the effects of winds and wind gusts on the

sound levels being measured. Typically made of open cell polyurethane foam and spherically shaped.

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