

## GLOSSARY OF ACOUSTICAL TERMS

Abnormal noise events	Noises that are sufficiently infrequent as to be uncharacteristic of an area or that occur so close to the microphone as to dominate the measurements in an unrealistic manner. Consideration must be given to deleting occurrences of abnormal noise from the measurements to obtain a reasonably accurate representation of the sound environment. Examples of abnormal noises include a dog barking close to the microphone, a vehicle passing nearby, people talking in the vicinity of the microphone in a quiet environment, or a passing road grader.
Absorption	Conversion of sound energy into another form of energy, usually heat, when passing through an acoustical medium or at a boundary
Absorption coefficient ( <i>sound absorption coefficient</i> )	Ratio of the dissipated and transmitted sound power to the incident sound power. The sound absorption coefficient is given as a number between 0 and 1 with 0 being completely acoustically reflective and 1 being completely acoustically absorptive.
Ambient noise [AER Directive 038]	All noises that exist in an area and are not related to a facility covered by AER <i>Directive 038</i> . Ambient noise includes sound from other industrial noise not subject Directive 038, transportation sources, animals, and nature.
Ambient sound level (ASL) [AER Directive 038]	The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ASL does not include any energy related industrial component and must be measured without it. The ASL can be measured when the sound level in an area is not believed to be represented by the basic sound levels (BSLs). The ASL must be measured under representative conditions. As with comprehensive sound levels, representative conditions do not constitute absolute worst-case conditions (i.e., the most quiet day in this case) but conditions that portray typical conditions for the area. Also see <i>Representative conditions</i> .
A-weighted sound level	The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies.
Background noise	The total noise from all sources that currently exist in an area. Background noise includes sounds from the energy industry, as well as other industrial noise not subject to this directive, transportation sources, animals, and nature.
Bands (octave, 1/3 octave)	A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it. The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency.
Basic sound level (BSL) [AER Directive 038]	The A-weighted Leq sound level commonly observed to occur in the designated land-use categories with industrial presence. The BSL is assumed to be 5 dBA above the ASL and is set out in Table 2.

Beat	A phenomena of slow amplitude modulation produced by interference between two or more simple harmonic signals, when the frequency difference is a small fraction of either frequency. The observable result is a periodic increase, then decrease, then increase of either sound pressure level and/or vibration amplitude as the multiple sources interfere with each other in varying stages of constructive and destructive interference.
Calibration	The procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency. Field calibration takes place before and after the sound level measurements.
Category [AER Directive 038]	A classification of a dwelling unit in relation to transportation routes used to arrive at a BSL.
Category 1 [AER Directive 038]	Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers. Also see <i>Category</i> .
Category 2 [AER Directive 038]	Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers. Also see <i>Category</i> .
Category 3 [AER Directive 038]	Dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers. Also see <i>Category</i> .
Class A adjustment [AER Directive 038]	Consists of the sum of adjustments that account for the adjustment seasonal nature of the noise source (cannot be used for design state) and the actual ambient sound level in an area. It cannot exceed +10 dBA. The Class A adjustment is added to the BSL, the daytime adjustment, and the Class B adjustment to arrive at the permissible sound level.
Class B adjustment [AER Directive 038]	An adjustment based on the duration of a noisy activity that recognizes that additional noise can be tolerated if it is known that the duration will be limited. An adjustment of B1, B2, B3, or B4 may be selected as applicable.
Comprehensive sound level (CSL) [AER Directive 038]	The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The CSL does include industrial components and must be measured with them, but it should exclude abnormal noise events. The CSL is used to determine whether a facility is in compliance with <i>Directive 038</i> . Also see <i>Representative conditions</i> .
C-weighted sound level	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.
Day-time	Typically Defined as the hours from 07:00 to 22:00. This time span can differ in various jurisdictions.
Daytime adjustment [AER Directive 038]	An adjustment that allows a 10 dBA increase because daytime ambient sound levels are generally about 10 dBA higher than nighttime values.

Deferred facility [AER Directive 038]	Facilities constructed and in operation prior to October 1988. These facilities do not have to demonstrate compliance in the absence of a complaint. This does not exempt them from the requirements but does recognize that they were potentially designed without the same considerations for noise as facilities approved after the date when the first comprehensive noise control directive ( <i>ID 88-1</i> ) was published and put into effect.
Density per quarter section [AER Directive 038]	Refers to a quarter section with the affected dwelling at the centre (a quarter-mile/451m radius). For quarter sections with various land uses or with mixed densities, the density chosen must be factored for the area under consideration.
dB (decibel)	A unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale. The internationally agreed upon threshold for hearing is $2 \times 10^{-5}$ Pa (0 dB), while the sensation of pain is about $2 \times 10^2$ Pa (140 dB). Generally, an increase of 10 dB is perceived as twice as loud. The sound pressure level (SPL) in dB is defined as:
	$SPL = 10 \log_{10} \left[ \frac{P_{RMS}^2}{P_{ref}^2} \right] = 20 \log_{10} \left[ \frac{P_{RMS}}{P_{ref}} \right]$
	Where:
	<i>SPL</i> =Sound Pressure Level in dB
	<i>P<sub>RMS</sub></i> =Root Mean Square measured pressure (Pa)
	<i>P<sub>ref</sub></i> =Reference sound pressure level ( <i>P<sub>ref</sub></i> = $2 \times 10^{-5}$ Pa = 20 μPa)
dBA	The decibel (dB) sound pressure level filtered through the A filtering network to approximate human hearing response at low intensities. Also see <i>dB</i> and <i>A-weighted sound level</i> .
Dwelling unit [AER Directive 038]	Any permanently or seasonally occupied residence with the exception of an employee or worker residence, dormitory, or construction camp located within an industrial plant boundary. Trailer parks and campgrounds may qualify as a dwelling unit if it can be demonstrated that they are in regular and consistent use during the applicable season.
Dwelling unit (most impacted) [AER Directive 038]	The nearest dwelling unit may not necessarily be the one most adversely affected because of factors such as topography or man-made features. For example, the nearest dwelling unit to a facility may be behind an intervening ridge, while a more distant dwelling unit may be in direct line of sight with the facility. Care must be taken in determining the most impacted dwelling unit. Also see <i>Dwelling unit</i> .
Emergency [AER Directive 038]	An unplanned event requiring immediate action to prevent loss of life or property. Events occurring more than four times a year are not considered unplanned.

Energy equivalent sound Level

The Leq is the average A-weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval, T. The time interval must be specified in order for the Leq to be valid. If a sound level is constant over the measurement period, the Leq will equal the constant sound level.

$$L_{eq} = 10 \log_{10} \left[ \frac{1}{T} \int_0^T 10^{\frac{dB}{10}} dT \right] = 10 \log_{10} \left[ \frac{1}{T} \int_0^T \frac{P^2}{P_{ref}^2} dT \right]$$

Facility  
[AER Directive 038]

A facility includes, but is not limited to, energy developments licensed under *Directive 056: Energy Development Applications and Schedules*, developments that receive permits or licenses under the *Coal Conservation Act* and *Regulations* (AR 270/81), oil sands sites licensed or approved under the *Oil Sands Conservation Act* and *Regulation* (AR 76/88), industrial development permit facilities (some chemical plants, fertilizer plants, and refineries), and electrical generation facilities (including wind turbines), as defined in the *Hydro and Electric Energy Act*. For the purposes of *Directive 038*, all of the above are referred to as facilities except where otherwise stated. A new facility is one that was not in operation prior to the effective date of the 2006 edition of *Directive 038*. An existing facility is one that was in operation prior to the effective date of the Directive.

Far field

The far field may consist of two parts, the free part and the reverberant part. In the free part, the sound pressure level obeys the inverse-square law (6 dBA loss per doubling of distance for a point source). The reverberant part exists for enclosed or semi-enclosed situations where there are many reflected sound waves from all directions. An example of a reverberant field is industrial equipment enclosed in a room.

Fast Fourier Transform (FFT)

A method of noise and vibration measurements that results in constant bandwidth frequency discretization. FFT measurements are often conducted when a very detailed frequency spectral measurements is required (i.e. much finer than 1/3 octave bands)

Fast response

Fast response has a time constant of 125 milliseconds on a sound level meter. Also see *Slow response*.

Filter

A device separating the components of an incoming signal by its frequencies.

Frequency

The number of cycles of a periodic phenomenon per second. Unit: hertz (Hz)

Frequent aircraft flyovers  
[AER Directive 038]

Used in the assessment of categories as part of a site-specific analysis for dwellings that lie within a contour area with a noise exposure forecast (NEF) 25 or greater, as designated by Transport Canada. In the absence of any NEF contours for a local airport, Transport Canada is to be contacted for current air traffic statistics. In this case, to qualify for the BSL adjustment, a dwelling must be within 5 km of an airport that has a minimum of nine aircraft takeoffs or landings over the nighttime period. Also see *Noise exposure forecast*.

Heavy industrial area	Usually an area zoned by the appropriate municipality containing or meant to contain a concentration of large industrial complexes, thereby helping licensees avoid a multiplicity of industrial effects on surrounding residents. A buffer zone is generally established between the industrial facilities and where people live so that there are no residences situated among industrial facilities.
Heavy truck	Any truck having a gross vehicle weight of 12 000 kg or more and having three or more axles.
Heavily travelled road [AER Directive 038]	Generally includes highways and any other road where the average traffic count is at least 10 vehicles/hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern. The AER will use the 10 vehicles/hour criterion to determine whether highways qualify as heavily travelled during the nighttime period.
Hertz (Hz)	See <i>Frequency</i>
Industrial development permit facility [AER Directive 038]	Industrial development permit facility is any development where the total quantity of energy in the energy resource used in any year as a raw material or fuel, or both, in the industrial or manufacturing operation exceeds one petajoule, and the quantity of energy in the energy resource used in that year as a raw material in the industrial or manufacturing operation exceeds 100 terajoules, such as oil refinery or chemical production plants.
Impact Insulation Class (IIC)	A single number rating of the measured impact noise levels resulting from a standard tapping machine located on the floor above the measured space. Typical IIC measurements and assessments follow the ASTM E 1007 standard
Insertion Loss	The sound level reduction, either in broadband dB or fractional octave band dB sound levels, realized by inserting a silencing element where none was originally present. Unit: decibel (dB)
Intensity	The flow of sound energy per unit area in the direction of the local acoustic particle velocity. Unit: Watts per square meter
Isolation analysis techniques	Various sound measurements and analytical skills used to separate out various sound sources and obtain the sound level from the source of interest alone.
Leq	See <i>Energy equivalent sound level</i> .
Linear weighting (or Z weighting)	The sound level measured with the linear weighting measures the acoustic pressure without any adjustment for the sensitivity of human hearing. It is a direct measure in decibels of the variation in air pressure and is often referred to as the "Sound Pressure Level." This level is sometimes called the "linear weighted level" or "the unweighted level," as it includes no frequency weighting beyond the tolerances and limits of the sound level meter being used for the measurements.
Low Frequency Noise (LFN) [AER Directive 038]	Where a clear tone is present below and including the 250 Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.

Masking	The process by which the threshold of audibility of one sound is raised by the presence of another (masking) sound
Microphone	Transducer that converts the mechanical motion measured from a sound wave impinging on the surface into an electrical output signal that can be measured by a sound level meter or similar device
Near field	The region close to the source where the inverse-square law (6 dBA loss per doubling of distance for a point source) does not apply. Usually this region is located within a few wavelengths of the source and is also controlled by the dimensions of the source.
Night-time	Typically Defined as the hours from 22:00 to 07:00. This time span can differ in various jurisdictions.
Noise	Generally associated with the unwanted portion of sound.
Noise Criteria (NC)	A single number rating used to quantify the sound level within a room, typically resulting from the ventilation equipment noise
Noise exposure forecast (NEF)	The NEF contours are site specific to each airport and take into account such factors as traffic levels, proximity to runways, flight paths, and aircraft type and size.
Noise impact assessment (NIA) [AER Directive 038]	An NIA identifies the expected sound level emanating from a facility as measured 15 m from the nearest or most impacted permanently or seasonally occupied dwelling. It also identifies what the permissible sound level is and how it was calculated.
Noise Reduction Coefficient (NRC)	Arithmetic average of the sound absorption coefficients of a material at 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz
Noise Reduction Rating (NRR)	A single number rating for hearing protector devices. Unit: decibel (dB)
Pascal (Pa)	Unit of pressure corresponding to a force of 1 Newton acting uniformly on an area of 1 square meter.
Pass-by	The movement of a vehicle past the point of measurement and observed as an increase in sound level to a peak, followed by a decrease as the vehicle moves away from the microphone.
Period	The time interval over which an oscillation or event repeats itself
Permanent facility [AER Directive 038]	Any existing or proposed facility that will be at a location longer than 60 days.
Permanently occupied dwelling [AER Directive 038]	A fixed residence occupied on a full-time basis.
Permissible sound level (PSL) [AER Directive 038]	The maximum sound level that a facility must not exceed at a point 15 m from the nearest or most impacted dwelling unit. The PSL is the sum of the BSL, daytime adjustment, Class A adjustment, and Class B adjustment.
Pink Noise	A broadband random noise whose power spectrum is inversely proportional to the frequency (-1 dB per 1/3 octave, -3 dB per octave), thus giving it a constant power spectrum per octave or 1/3 octave band.
Pristine area [AER Directive 038]	A pure, natural area that might have a residence but no industrial presence, including energy, agricultural, forestry, manufacturing, recreational, or other industries that already impact the noise environment.

Rail lines [AER Directive 038]	Includes any rail line where there is a minimum of one 25-car train passage during every nighttime period.
Representative conditions [AER Directive 038]	Those conditions typical for an area and/or the nature of a complaint. For ASLs, these are conditions that portray the typical activities for the area, not the quietest time. For CSLs, these do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated. Sound levels must be taken only when representative conditions exist; this may necessitate a survey of extensive duration (two or more consecutive nights).
Residence	A permanent or seasonally occupied dwelling.
Resident	A person occupying a dwelling unit on a seasonal or permanent basis.
Reverberant Sound Field	Portion of the sound field in the test room over which the influence of sound received directly from the source negligible
Reverberation Time (RT, RT60)	The time required for the sound pressure level in an initially steady sound field to decrease by 60 dB after the sound has stopped. Unit: Seconds (s). The actual measurement of reverberation time is typically less than a 60 dB reduction (i.e. typically a 20 dB or 30 dB reduction) and then the time is extrapolated linearly to an equivalent 60 dB reduction
Room Criteria (RC)	A single number rating used to quantify the sound level within a room, typically resulting from the ventilation equipment noise. Room criteria was implemented to replace the Noise Criteria (NC) with the inclusion of more low frequency noise criteria
Seasonally occupied dwelling [AER Directive 038]	A fixed residence that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The residence must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or mobile homes are examples of seasonally occupied dwellings, while a holiday trailer simply pulled onto a site is not.
Summertime conditions [AER Directive 038]	Ground cover and temperatures that do not meet the definition for wintertime conditions. These can occur at any time of the year.
Slow response	A standardized detector response on a sound level meter that dampens the movement of displays so that rapidly fluctuating sound levels may be read. Slow response has a time constant of 1 second, which helps average out the display fluctuations. Fast response has a time constant of 125 milliseconds.
Sound level meter	An instrument designed and calibrated to respond to sound and to give objective, reproducible measurements of sound pressure level. It normally has several features that would enable its frequency response and averaging times to be changed to make it suitable to simulate the response of the human ear.
Sound monitoring survey	The measurement and recording of sound levels and pertinent related information over a given time period.



*Directive 038* sets out two types of monitoring surveys. The first helps determine the PSL and consists of a 24-hour continuous sound monitoring survey conducted 15 m from the nearest or most impacted dwelling unit without any energy related industrial presence. This type of sound survey can be used to determine an ASL. Also see *Ambient sound level*.

The second type of sound monitoring survey is required to determine a facility's compliance with *Directive 038*. The CSL is determined by conducting a continuous sound monitoring survey over a minimum 6-hour period to a maximum 24-hour period. The need for extended sound monitoring surveys (greater than 24 hours) may exist and should be discussed with the AER prior to proceeding. Also see *Comprehensive sound level*.

Sound pressure level (SPL)

The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. Because human reaction and material behaviors vary with frequency, the sound pressure level may be measured using frequency bands or with an overall weighting scale such as the A-weighting system. The sound pressure level depends on the noise sources, as well as on the location and environment of the measurement path. *See also dB (decibel)*

Sound power level  
(SWL, PWL, or Lw)

The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level (in dB) of a noise source, emitting sound energy  $W$  in watts, is given by:

$$SWL = 10 \log_{10} \left[ \frac{W}{W_{ref}} \right] , \quad W_{ref} = 10^{-12} \text{ Watts}$$

One way to describe the differences between sound pressure level and sound power level is to use the analogy of a light bulb, as follows:



	<u>Light Bulb</u>	<u>Sound Source</u>
<b>Total Power</b>	- A 100W bulb always consumes 100W no matter where it is used.	- A 100W sound source is always 100W
<b>Efficiency</b>	- The amount of energy emitted as light is only a fraction of the rated wattage (Approx. 2%)	- The amount of sound energy radiated from a mechanical machine is only a fraction of the total machine power (typically measured in ppm)
<b>Measurements</b>	- The amount of light emitted is not easy to measure but the light level in a given spot is	- The sound power level is not easy to measure, but the sound pressure level is
<b>Absorption</b>	- If the bulb is placed in a completely black room, there will be a certain amount of light in the room	- If a sound source is placed in a room with completely sound absorptive surfaces, there will be a certain sound pressure level in the room
<b>Reflection</b>	- If the bulb is placed in a similar room with completely white walls, there will be more light because of reflections	- If the sound source is placed in a similar room with completely hard reflecting walls, the total sound pressure level in the room will be much higher
<b>Volume</b>	- If the bulb is placed in a much larger white room, there will appear to be less light because of the larger volume	- If the sound source is placed in a much larger, reflective room, the sound pressure level will be lower due to the extra volume
<b>Multi-sources</b>	- If another, similar bulb is added, there will be more light. As more and more bulb are added the incremental difference will be less each time	- If another, similar sound source is added, there will be a higher sound pressure level. As more and more sources are added, the incremental differences will be less each time.
<b>Ambient Interference</b>	- If the bulb is moved outside it will not appear as bright during the day-time as during the night-time due to the ambient light levels	- If the sound source is located in an area with high ambient sound levels (such as a busy street in day-time) it will not be as noticeable as it would be in an area with much lower ambient sound levels (such as the same street during night-time)
<b>Annoyance</b>	- The annoyance level for brightness of a light is different for every person	- The annoyance level for the loudness of a sound is different for every person

Sound Transmission Class (STC)	A single number rating for describing the sound transmission loss of a wall or partition. Typical field measurements and assessments of STC follow the ASTM E336 standard
Speed of Sound	The velocity at which sound travels through a particular medium. In air at room temperature (i.e. 20 Celsius), the speed of sound is approximately 343 m/s
Spectrum	A wide range or sequence of frequencies.
Temporary facility [AER Directive 038]	Any facility that will be in operation less than 60 days.
Tonal components (low frequency) [AER Directive 038]	The test for the presence of tonal components consists of two parts. The first must demonstrate that the sound pressure level of any one of the slow-response, A-weighted, 1/3 octave bands between 20 and 250 Hz is 10 dBA or more than the sound pressure level of at least one of the adjacent bands within two 1/3 octave bandwidths. In addition, there must be a minimum of a 5 dBA drop from the band containing the tone within 2 bandwidths on the opposite side. The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.
Transmission Loss	The sound level reduction as measured before and after a silencing element. Unit: decibel (dB)
Valid complaint [AER Directive 038]	Upon investigation (which includes the completion of the Noise Complaint Investigation form in Appendix 7 of AER Directive 038), it is determined by the licensee or the AER that there may be potential for noise levels to exceed the PSL.
Wavelength	Distance in the direction of propagation of a sinusoidal wave between two successive points of either maxima or minima. Unit: meter (m)
Windscreen	A specialized piece of porous sponge that fits over the microphone in order to reduce the noise generated by the wind blowing around the microphone. Useful in moderately low wind speeds. Generally, outdoor measurements are not recommended when wind speeds exceed 15 km/hr, as the wind-induced noise on the microphone becomes of the same magnitude as the levels of noise being measured.
White noise	A noise with a power spectrum which is independent of frequency. See <i>pink noise</i>