

NOISE CONTROL

Sound is physically a rapid alteration of air pressure above and below atmospheric pressure.

Pure tone is a sound that contains only one frequency (expressed as a sine curve).

Pitch is determined primarily by frequency.

Sound pressure is the amplitude or magnitude of sound.

Wavelength is the distance a sound wave travels in one cycle or period.

- The **speed with which sound travels through a particular medium is dependent on the compressibility and density** of the medium.
- As sound travels through a medium, it loses energy or amplitude in two ways: molecular heating and geometric spreading.
- **For every doubling of distance, the intensity is reduced by a factor of 4.**

Noise is unwanted sound.

Noise pollution is the condition in which noise has characteristics and duration injurious to public health and welfare or unreasonably interferes with the comfortable enjoyment of life and property in such areas as are affected by noise.

Ambient noise is the total noise in a given situation or environment.

Noise level is the weighted sounds pressure level in dBA.

- **The A-weighted scale approximates the frequency response of the human ear.**

Frequency is the number of times a complete cycle of pressure variation occurs in 1 second.

Frequency:

- **Determines pitch**
- Sounds w/frequency of 30 Hz are very low pitch
- Sounds w/frequency of 15,000 Hz are very high pitch
- Audibility of sound is dependent in both frequency and sound pressure level
- Most sounds are in the sonic frequency range of 20–20,000 Hz

Decibel (dB) is a dimensionless unit to express physical intensity or sound pressure levels.

Decibel:

- **The threshold of pain is 120 dBA**
- **The decibel is 1/10 of the bel**
- Scales
 - **A**
 - Simulates frequency bias of the human ear
 - Most commonly used in measurements regarding impact on humans
 - Read in dBA
 - **B**
 - Used for moderately loud sounds
 - **C**
 - Used for very loud sounds
 - **D**
 - Used to measure and compare effect of airplane noise on the human ear

Intensity of a sound wave is the energy transferred per unit time (in sec) through a unit area normal to the direction of propagation.

Loudness (amplitude) of sound is the sound level or sound pressure level as perceived by an observer.

- Apparent loudness varies with the sound pressure and frequency (pitch) of the sound.
- **One sone = 40 phons**
- Loudness levels are usually expressed in phons.
- Each doubling of sones increases phons by 10.

Day-night average sound level (DNL) system:

- The 24-hour average sound level
- Expressed in dB
- Obtained after addition of a 10-dB penalty for sound levels that occur at night between 10 p.m. and 7 a.m.

Effects of noise – a health hazard:

- About \$835 M compensation was paid to workers from 1978–1987
- Major factors leading to hearing loss
 - Intensity (sound pressure levels in dB)
 - Frequency content
 - Time duration of exposure
 - Repeated impact
- Sound level > 80 dBA calls for study of the cause
- **Sound level > 90 dBA should be considered unsafe** for daily exposure over a period of months

- EPA reports identify **24-hour exposure level of below 70 dBA safe** as the level of environmental noise that will prevent any measurable hearing loss over a lifetime
- Levels of 55 dBA outdoors and 45 dBA indoors are identified as preventing annoyance and not interfering with spoken conversation

Sources of noise:

- Transportation activities
 - Motor vehicles
- Industrial activities
- Urban activities
- Commercial activities
- Household appliances and equipment
 - Dishwashers
 - Garbage disposal units
 - Air conditioners
 - Power lawn mowers
 - Home music amplifiers

Sound-level meter is used to measure sound pressure level.

Sound level meter:

- The basic instrument for noise measurement
- Available to cover range of 20– 180 dB
- Specs refer to American National Standards Institute (ANSI)
- Three types:
 - Type I = Highest quality
 - **Type II = Most commonly used by public health officials**
 - Type III = Lowest quality
- The A-weighted scale is most commonly used
- Provides settings for F (fast-time response) and S (**slow-time response**)
 - Slow setting easier to read in factory setting and required by OSHA for compliance purposes

Noise dosimeter will measure the amount of potentially injurious noise to which an individual is exposed over a period of time (but does not identify sources).

Sound analyzer = octave-band analyzer is most common

- Impact noise analyzer is used to measure the peak level and duration of impact noise.
- Examples of impact noise...drop hammer machines, gun fire

Background noise is the noise in the absence of the sound being measured that may contribute to and obscure the sound being measured.

- Background noise should be at least 10 dB lower than the noise being measured to introduce negligible error due to interference.
- **It is best to reduce noise at the source if possible.**

Sound absorption is the amount of sound energy a material can absorb as a function of its absorption coefficient (α) at a specified frequency.

- Material w/an α of 0.8 will absorb 80% of the incident sound energy.
- **A material that absorbs all incident energy will have an α of 1.**
- Sound absorption of a surface is measure in sabins.

Sound transmission loss (TL) is the ratio of energy passing through a wall, floor, or ceiling to the energy striking it—how effective a material is in stopping the passage of sound.

- **TL increases as frequency decreases.**