

APPENDIX A – ACOUSTICAL TERMINOLOGY

The term “sound level” is often used to describe two different sound characteristics: sound power and sound pressure. Every source that produces sound has a sound power level. The sound power level is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the surrounding environment. The acoustical energy produced by a source propagates through media as pressure fluctuations. These pressure fluctuations, also called sound pressure, are what human ears hear and microphones measure.

Sound is physically characterized by amplitude and frequency. The amplitude of sound is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPascals). The reference sound pressure corresponds to the typical threshold of human hearing. To the average listener, a 3-dB change in a continuous broadband sound is generally considered “just barely perceptible”; a 5-dB change is generally considered “clearly noticeable”; and a 10-dB change is generally considered a doubling (or halving, if the sound is decreasing) of the apparent loudness.

Sound waves can occur at many different wavelengths, also known as the frequency. Frequency is measured in hertz (Hz), and is the number of wave cycles per second that occur. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the lower and higher frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels, or dBA. For reference, the A-weighted sound pressure level and subjective loudness associated with some common sound sources are listed in Table 1.

Sound in the environment is constantly fluctuating; for example, when a car drives by, a dog barks, or a plane passes overhead. Therefore, sound metrics have been developed to quantify fluctuating environmental sound levels. These metrics include the exceedance sound level, L_x , which is the sound level exceeded during “x” percent of the sampling period. The most common L_x value is L_{90} . The L_{90} is the sound level exceeded during 90 percent of the sampling period and represents the sound level without the influence of short-term, loud transient sound sources. The arithmetic average of the varying sound

over a given time period is called the L_{eq} . L_{eq} and L_{90} levels are presented in various places throughout this study.

Table 1: Typical Sound Pressure Levels Associated with Common Sound Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 feet	--
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 feet	--
120	Threshold of feeling	Elevated train	Hard rock band
110	--	Jet flyover at 1,000 feet	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 feet, auto horn at 10 feet, crowd sound at football game	--
90	--	Propeller plane flyover at 1,000 feet, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 feet	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner
60	Moderate	Air-conditioner condenser at 15 feet, near highway traffic	General office
50	Quiet	--	Private office
40	--	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Inside average residence (without TV and stereo)
20	--	Rustling leaves	Quiet theater, whisper
10	Just audible	--	Human breathing
0	Threshold of hearing	--	--

Source: Adapted from *Architectural Acoustics*, M. David Egan, 1988, and *Architectural Graphic Standards*, Ramsey and Sleeper, 1994.

Some sounds contain many frequencies while others contain a singular frequency, or groupings of frequencies, that stand out from adjacent frequencies. Those sounds that contain a singular frequency that is louder than the adjacent frequency bands are sometimes called prominent discrete tones or pure tones.



At quieter sound levels, pure tones can be more noticeable to people than sounds that do not include a pure tone, depending on the frequencies involved. As with all sounds, however, experiencing pure tones can be subjective. Also, pure tones are defined differently in various locales across the country.

Sound can be analyzed for frequency components. These frequency components are described in the American National Standards Institute (ANSI) S1.11 and are commonly referred to as the octave band center frequency and the 1/3 octave band. The octave band is a set of frequencies used to describe a sound by lumping the entire spectrum of frequencies measured into specific frequency groups. These groups include any sound measured in any frequency, but the sound meter combines the discrete, adjacent frequencies together, as defined by ANSI.

