PreLab 9 – Sound Levels

Introduction

Nearly everyone has heard the word decibel, but a relatively small percentage of the people who have heard the word (or perhaps even of those who use the word) know what it means. In our lecture class, we have discussed what the word decibel means, so you are probably better informed in this respect than the average person, but you still probably do not have a good "feeling" for what the significance of the term decibel really is. The purpose of this lab is to provide you with a better feeling for what is meant when a sound intensity level or pressure level is described as being a certain number of decibels, so that you do not feel completely ignorant when you encounter this term in a newspaper article or elsewhere.

In our lecture class, we have mentioned that the sound intensity level (in dB) of a sound is given by

$$\mathrm{SIL} = 10 \log\left(\frac{I}{I_0}\right)$$

where I is the intensity of that sound in Watts/m^2, and I_0 is the threshold intensity, which is defined as 10^{-12} Watts/m^2. The threshold intensity is a rough indication of the softest sound (in the vicinity of 1000 Hz) which can be heard by a person with normal hearing. Thus basically, the intensity level of a sound (in decibels) provides information on how that sound level compares with the softest sound level (or threshold level) which a person can hear.

The sound level meter gives an indication of a quantity called the sound pressure level (in dB). For our purposes, and to a good approximation, the sound pressure level and the sound intensity level have the same value, so we can take the value of the sound pressure level (in dB) created by a particular sound as also being the value of the intensity level of that sound.

The sound level meter which you will use in this experiment is provided with three "weighting networks" referred to as A and C weighting, any one of which can be selected by depressing the appropriate switch on the meter. "A weighting" strongly discriminates against low-frequency sounds. This type of weighting is frequently used in sound level measurements because readings made with A weighting correspond reasonably well to the subjective impression of a person listening to the measured sound. "C weighting" is nearly independent of frequency from 32 Hz to 8 kHz and thus gives an indication of the true (unweighted) over-all sound pressure level.

Sound Pressure Level Measurements

Your lab instructor will discuss sound level measurements with you and show you how to operate the sound level meter. The object of this experiment is to measure and record the sound pressure levels (in dB) created by as many different types of sound sources as you can during your lab period, and in this way, to gain some familiarity with the sound levels associated with ordinary sound-producing phenomena which you encounter in a typical day. **Please handle the sound level meter with great care as it is a sensitive instrument.**

Record all relevant data in the Table of Sound Pressure Level Measurements provided below. You will probably want to make most of your measurements using the "slow" response mode of the meter. Please return the sound level

meter to your lab instructor by the end of your lab session.

Note: To prolong the life of the batteries, please turn the sound level meter off when you are not making a measurement.

For your reference, according to the Occupational Safety and Health Act (OSHA) of 1970, noise that measures above 115 dB(A) -- (the A refers to a reading using the "A weighting") is automatically **too high** for any exposure time over about 1 second. For softer sound levels, the following Table indicates the permissible exposure time.

Table of Permissible Noise Exposures

Duration (hours per day)	Sound level [dB(A)]
8	90
4	95
2	100
1	105
1/2	110
1/4	115

Loudness of typical sounds

Source of Sound	**β (dB)**
Nearby jet airplane	150
Jackhammer, machine gun	130
Siren, rock concert	120
Subway, power mower	100
Busy traffic	80
Vacuum cleaner	70
Normal conversation	50
Mosquito buzzing	40
Whisper	30
Rustling leaves	10
Threshold of hearing	0

LAB 9 & Lab Report

Name: _____

Sound levels

Equipment: Sound level meter, noise, walks around the building.

Procedure

Note: Make the measurements suggested below using A weighting and then C weighting. Record all the data indicated by the Table headings below, including Source of Sound, Estimated Distance from Meters, dB (A weighting), dB (C weighting), and your subjective judgments of the loudness of the sounds (such as "very quiet", "medium", "loud", "very loud", etc.). **Please cover your ears for all sounds which could be potentially damaging.**

Report:

1) Measure and record the sound pressure level (SPL) produced by the background noise in the lab, along with the other data requested in the Table.

2) Measure and record the SPL produced when your lab partner screams at you as loudly as he or she can. Try two or three difference distances from the sound level meter, e.g., 5 ft., 10 ft. and 15 ft. **Note to the screamer: Do not scream so loudly that you damage your vocal folds! Note to the listener: Cover your ears!**

3) Measure and record the SPL produced when your lab partner speaks to you in a normal fashion.

4) Measure and record the SPL produced by singing or playing various musical instruments (if they are available) for two or three different distances from the sound level meter.

5) Have your partner try to sing (or play a musical instrument) a few notes in a scale (within an octave) at what he or she considers to be the same loudness and record the actual sound levels produced when this is attempted.

(a) How large a variation typically occurs in the SPL from one note to the next**?**

6) If anyone has a car parked nearby, it would be interesting to measure the SPL produced by honking the horn, first when the sound level meter is relatively close to the horn, and then when the meter is several feet away from the car.

7) Whistle as loudly as you can and measure the SPL (cover your ears).

8) Record the SPL in a place which you consider to be very quiet (possibly a room next door where no one is present).

9) Turn up the volume of a stereo sound system (one will be set up in the lab) and record the SPL produced under various conditions of your choice.

10) Measure the sound pressure levels produced by anything else which intrigues you. Use your imagination, but keep in mind that you may look a bit suspicious walking around with a strange instrument

taking readings now and then.

Source of Sound	Estimated Distance from Meter	SPL (dB) A-weighting	SPL (dB) C-weighting	Comments on Subjective Loudness

11) In general, what differences do you find between your measurements made with A and C weighting**?**

12) Why do such differences exist**?**

13) Based upon the observations you have made during this experiment, what types of situations have exposed your ears to the highest sound levels during your life**?**

14) Do you think any of these situations were hazardous based upon the Table of Permissible Noise Exposures**?**