

HEARING CONSERVATION & NOISE EXPOSURE



Objectives

- ◆ What is sound?
- ◆ How the ear works
- ◆ How to measure noise
- ◆ What does OSHA says about noise?
- ◆ Reading hearing tests
- ◆ Hearing Protection

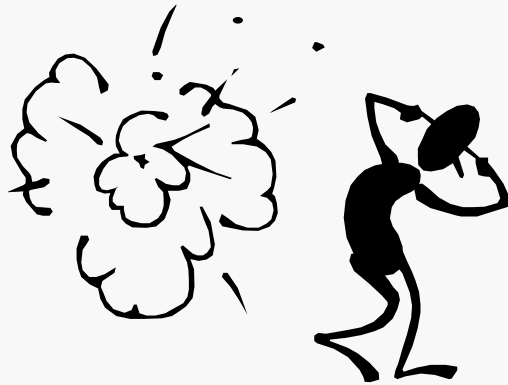
What is Sound?

- ◆ Hertz (Hz)

- Frequency a high or low pitch

- ◆ Decibels (dB)

- The loudness of the sound



Frequency

- ◆ Humans can typically hear between 20 - 20,000 Hz
- ◆ You can hear different frequencies better than others



Decibels

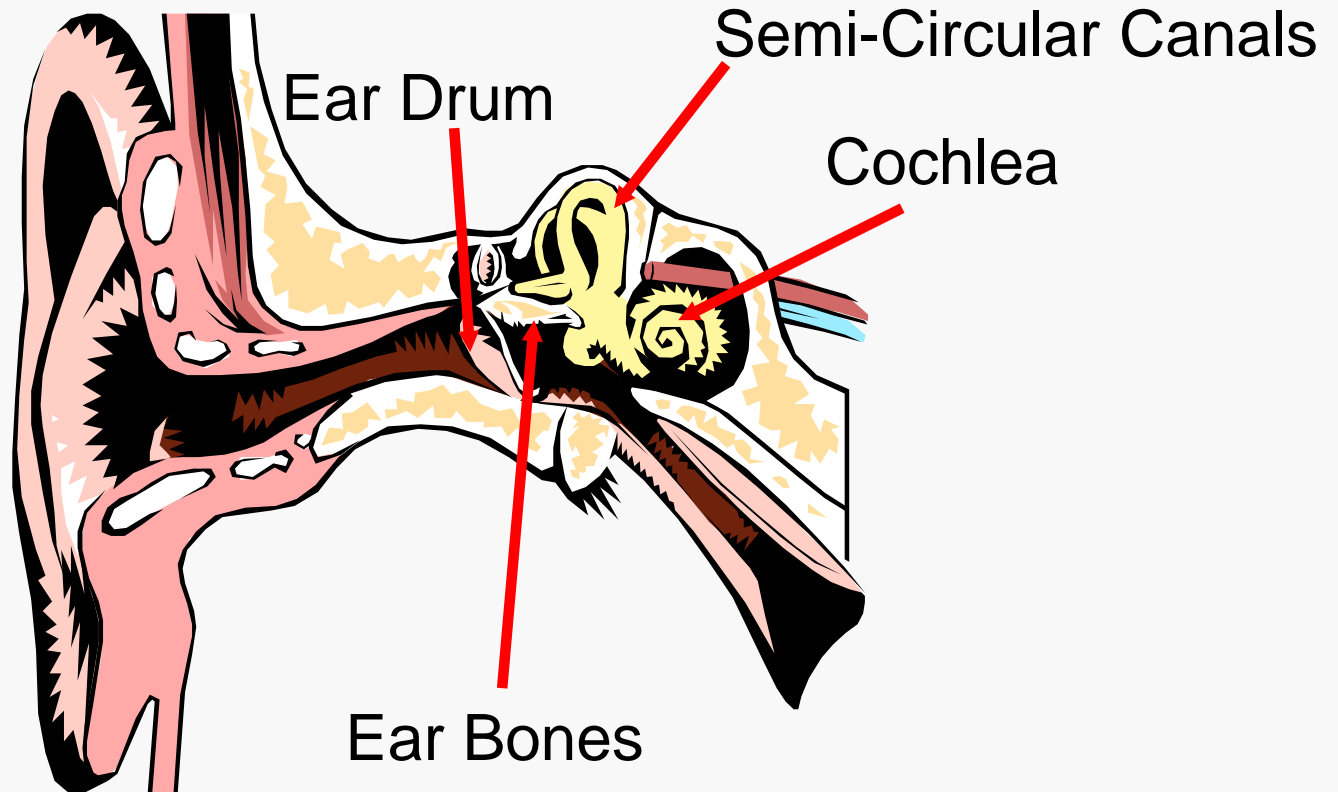


- ◆ The quietest sound most humans can detect is 0 dB
- ◆ Some humans can even hear sounds as quiet as -5 dB

The Loudness of Common Sounds

0 dB	Threshold of Hearing
30 dB	Soft Whisper
40 dB	Quiet Office
60 dB	Conversational Speech
80 dB	Very noisy restaurant
90 dB	Subway
110 dB	Woodworking
120 dB	Hydraulic press
140 dB	Threshold of Pain – Jet plane
180 dB	Rocket

Anatomy of the Ear



How do we Hear?

- ◆ The outer ear collects the soundwaves
- ◆ The waves hit the eardrum, and cause it to vibrate
- ◆ The vibrations are sent through the ear bones to the cochlea

Inside the Cochlea (snail shell)

- ◆ Delicate hair cells vibrate to different frequencies
- ◆ Hair cells detect the vibration, and send a signal to the brain
- ◆ Loud sounds destroy the hair cells, and they stop functioning **FOREVER!**

The Ear does something else too!

◆ The Semi-circular canals

- Three tubes laying perpendicular to one another
- Filled with fluid and tiny hair cells
- Depending on which way your head is tilted, the fluid moves the hair cells, and they send a signal to your brain

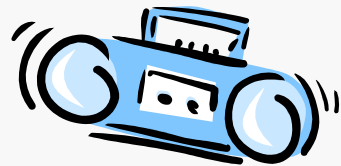


◆ Responsible for balance

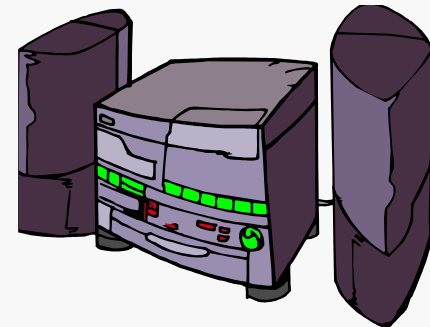
How to measure noise

- ◆ Decibels are measured on a **logarithmic scale**
- ◆ Every time you add **6 dB**, you **double** the sound pressure of the noise

80 dB



86 dB



Example

- ◆ In the field, we determined the loudness of two compressors right next to each other

89 dB

87 dB

- ◆ How loud is this area?
 - Do we add?
 - Do we add and take the average?

- ◆ Neither, because it is a log scale
- ◆ We use the following chart

Difference in dB values	Add to Higher Value
0 or 1 dB	3 dB
2 or 3 dB	2 dB
4 or 10 dB	1 dB
10 or more dB	0 dB

- ◆ $82 \text{ dB} + 83 \text{ dB} = 86 \text{ dB}$
- ◆ $87 \text{ dB} + 89 \text{ dB} = 91 \text{ dB}$

How does the Safety Person determine noise levels

◆ Sound level meter

- Determine the loudness (dB) of noise at any given moment

◆ Personal Dosimeters

- Worn by employees
- Measures the average loudness in an 8 hour work shift
- **“8hr. TWA”** (Time Weighted Average)
- Can also measure **noise dose**

What does OSHA say?

◆ At 85 dB (8hr. TWA) (50% Dose)

- Train employees
- Make hearing protection available
- Sample for noise levels
- Do hearing tests
- Notify employees of results

◆ At 90 dB or more (100% Dose)

- OSHA gets mad
- We must keep levels at or below 90 dB
- Or require hearing protection that will lower noise levels to to 90 dB

What are Our Noise Levels?

Area	Person 1 TWA	Person 2 TWA
Fabrication Shop	81 dB	84 dB
Vessel Shop	90 dB	91 dB
Engine Shop	88 dB	89 dB
Field Operations	84 dB	80 dB

Hearing Tests

- ◆ We must determine a baseline audiogram
- ◆ We test your hearing every year to determine if you have experienced a hearing loss (**Standard Threshold Shift**)
- ◆ **Standard Threshold Shift** - A loss of 10 dB or more at 2000, 3000, or 4000 Hz.

Audiogram

	200 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz
Baseline	5 dB	5 dB	0 dB	5 dB	10 dB	10 dB
Annual	5 dB	5 dB	10 dB	20 dB	35 dB	15 dB
Difference	0	0	10	15	25	5

Hearing Loss

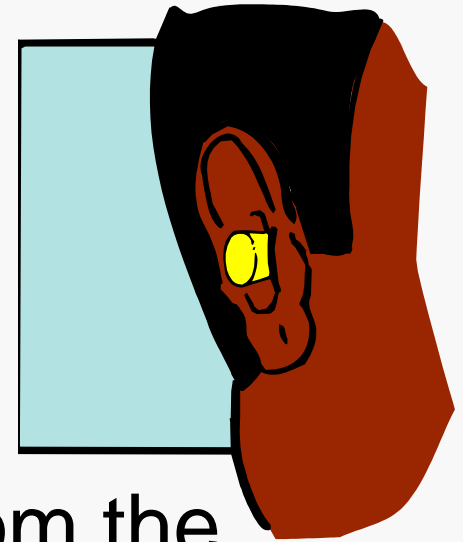
- ◆ Impact - One loud bang
- ◆ Cumulative - Years of a noisy environment
- ◆ Tinnitus - Ringing in the ears
- ◆ Presbycusis - Hearing loss due to aging



Hearing Protection

- ◆ **NRR** - Noise reduction rating

- Express - 25 NRR
- Classic - 29 NRR
- Max Lite - 30 NRR



- ◆ **DO NOT** Subtract the NRR from the noise level

- **WRONG** ($109 \text{ dB} - 25 \text{ NRR} = 84 \text{ dB}$)

- ◆ You must use the “**Safety Factor**”

Safety Factor

- ◆ OSHA says the hearing protection is designed to reduce the noise by the NRR, but that is unlikely to happen due to :
 - Leaks in the seal
 - Vibration
 - Improper insertion

◆ **(NRR - 7) / 2**

Example of NRR Protection

- ◆ The noise at a large compressor is **109 dB**
- ◆ You are wearing the Express plugs with an **NRR of 25**
- ◆ Do you have enough protection to place you below 90 dB level?

◆  $(\text{NRR } 25 - 7) = 18$

◆ $18 / 2 = 9$

◆ $109 \text{ dB} - 9 = 100$

◆ **YOU ARE ABOVE OSHA LIMITS OF 90 dB**

Final Thoughts

- ◆ Hearing is important
- ◆ In time, noise levels at 85 dB can permanently damage your hearing
- ◆ Wear your hearing protection both at work and at home
- ◆ Choose hearing protection with a high NRR, and wear it properly