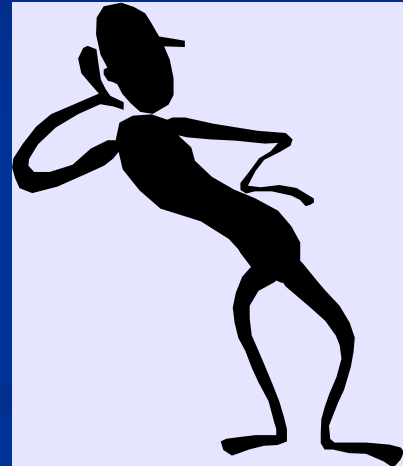




Occupational Hearing Loss



Types of Hearing Loss

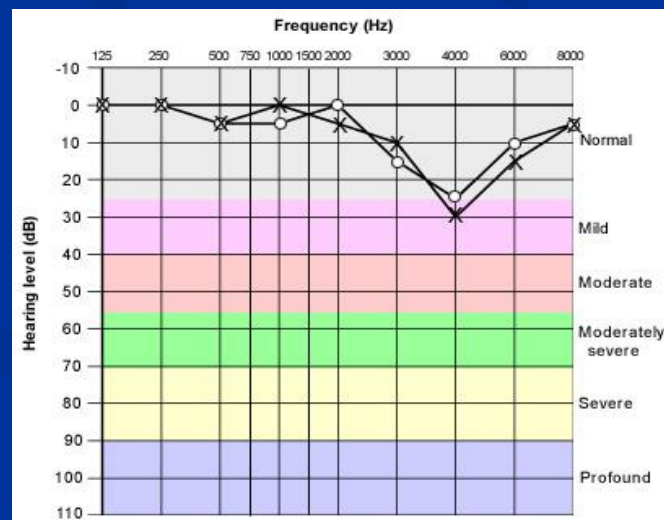
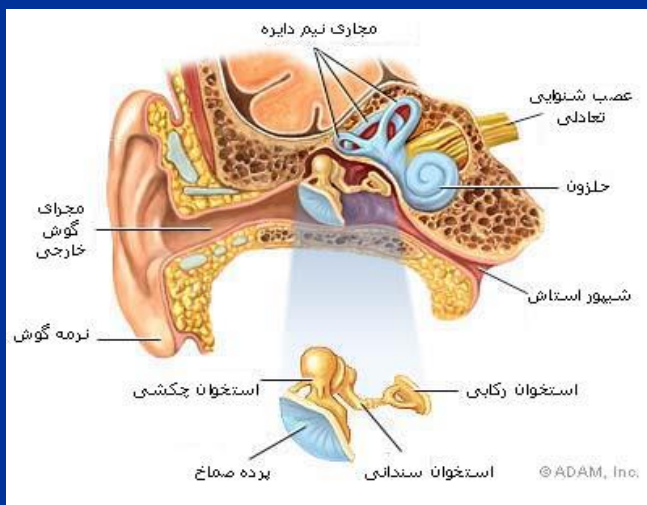
■ **CHL:** *Involvement of Outer and/or Middle Ear*

- Most often this is medically or surgically treatable
- Normal bone- conduction thresholds, but air- conduction poorer than normal by at least 10dB.

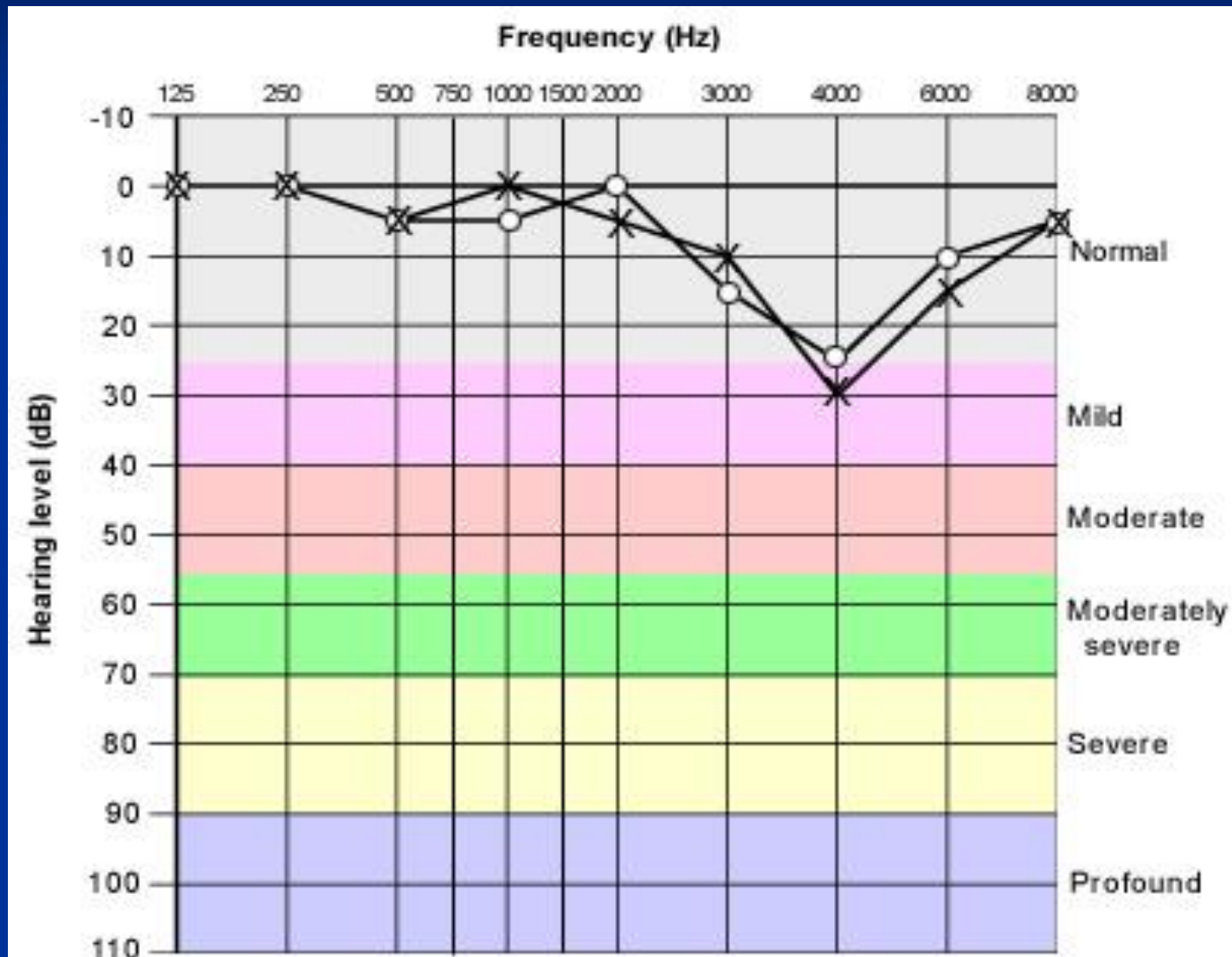
■ **SNHL:**

- bone- and air-conduction thresholds within 10 dB of each other, and thresholds are higher than 25 dB HL.

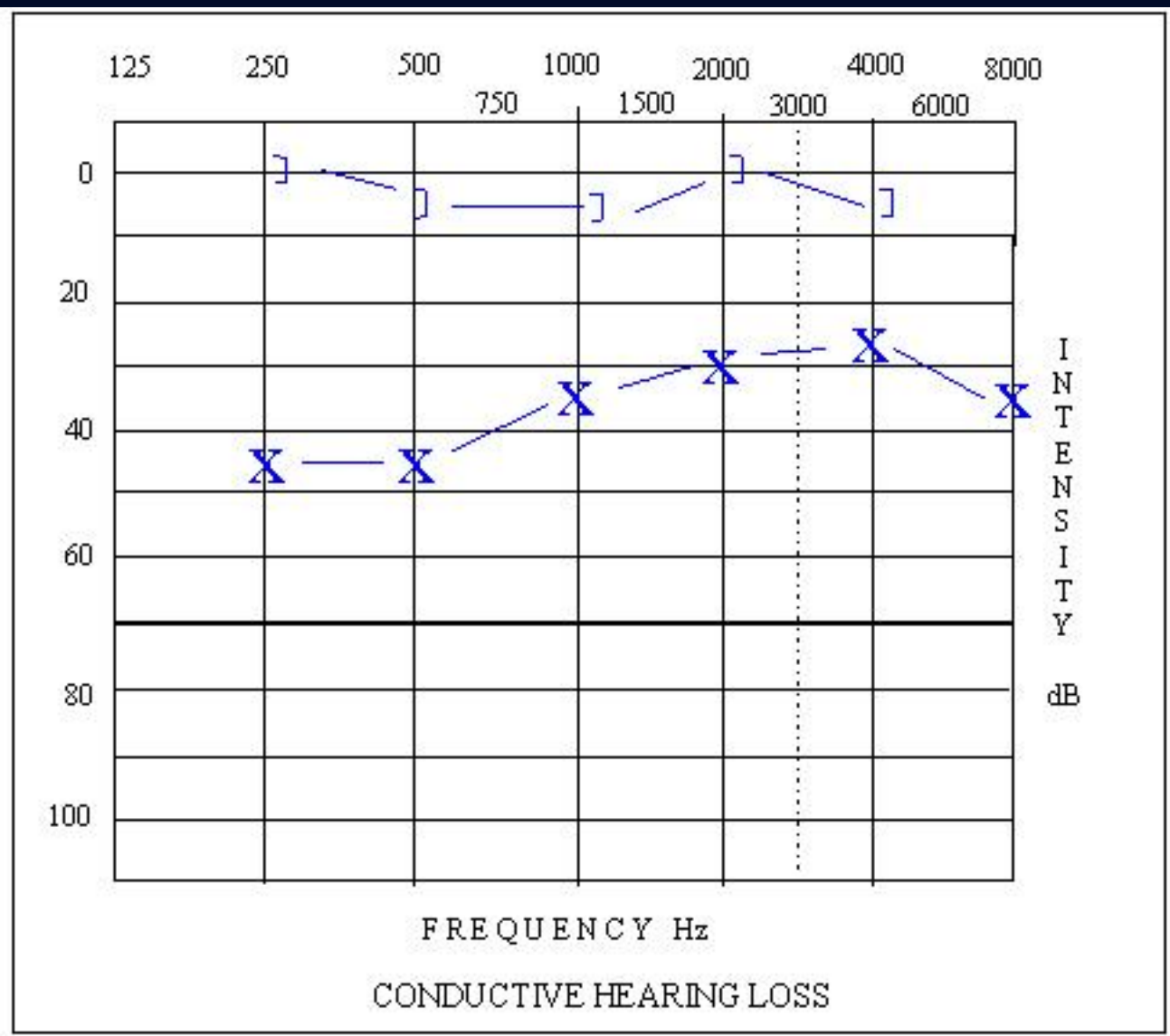
■ **Mixed HL:** Conductive & sensorineural



Pure Tone Audiometry

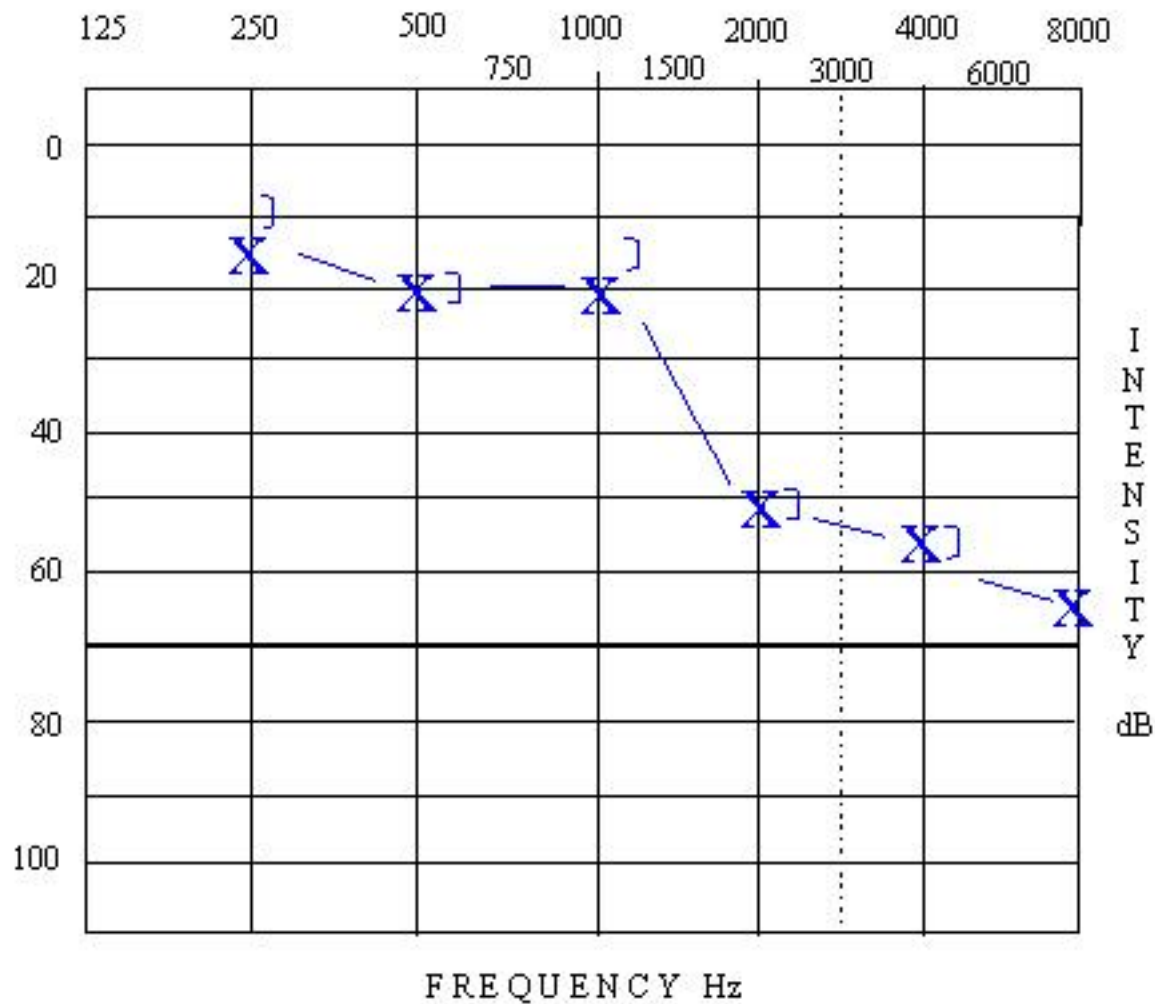


Key to symbols on an audiogram:		
	Right	Left
Air unmasked	○	X
Air masked	△	□
Bone unmasked	<	>
Bone masked	[]
Sound field	S	S
Aided	A	A



Key to symbols on an audiogram:

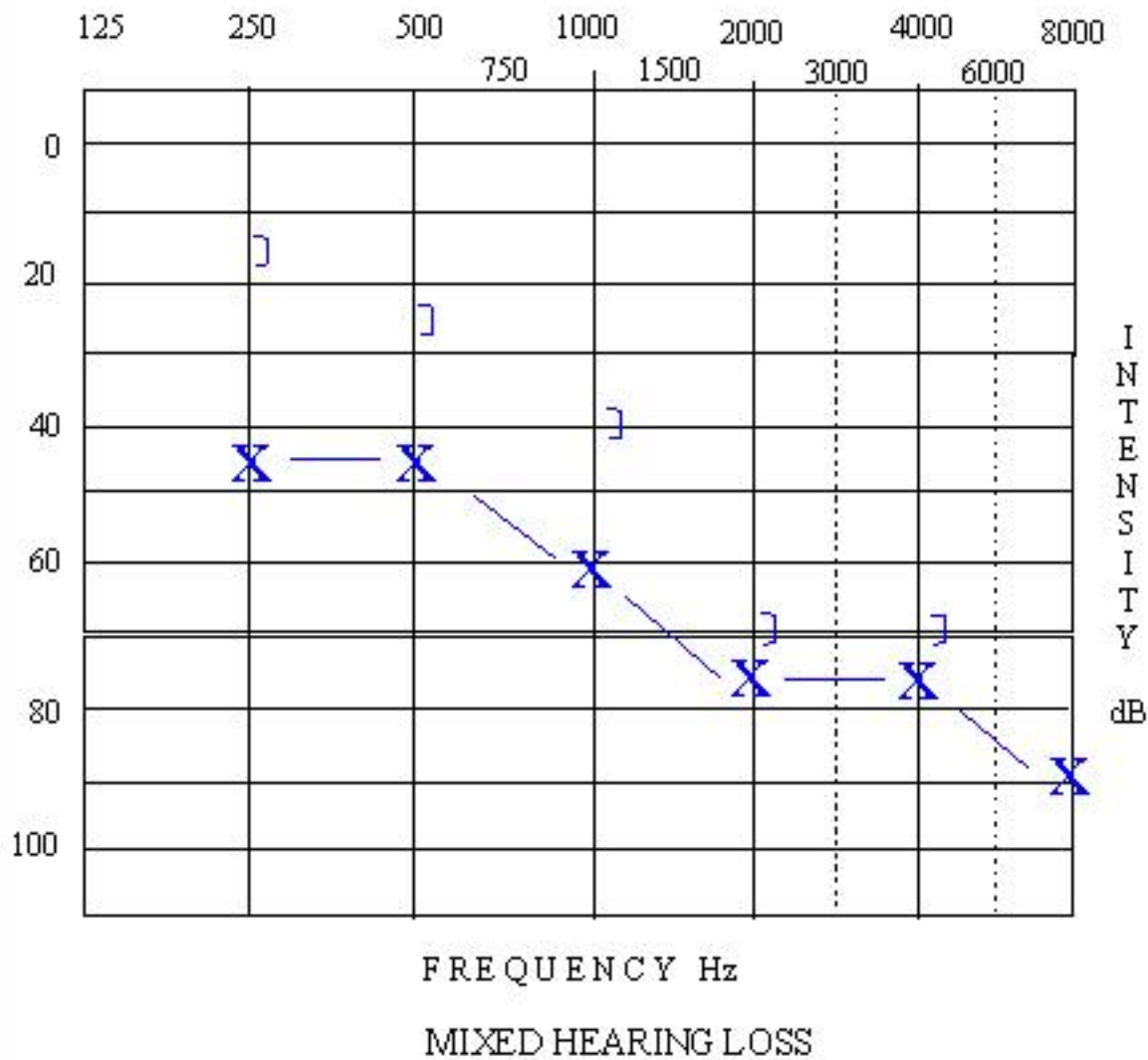
	Right	Left
Air unmasked	O	X
Air masked	△	□
Bone unmasked	<	>
Bone masked	[]
Sound field	S	S
Aided	A	A

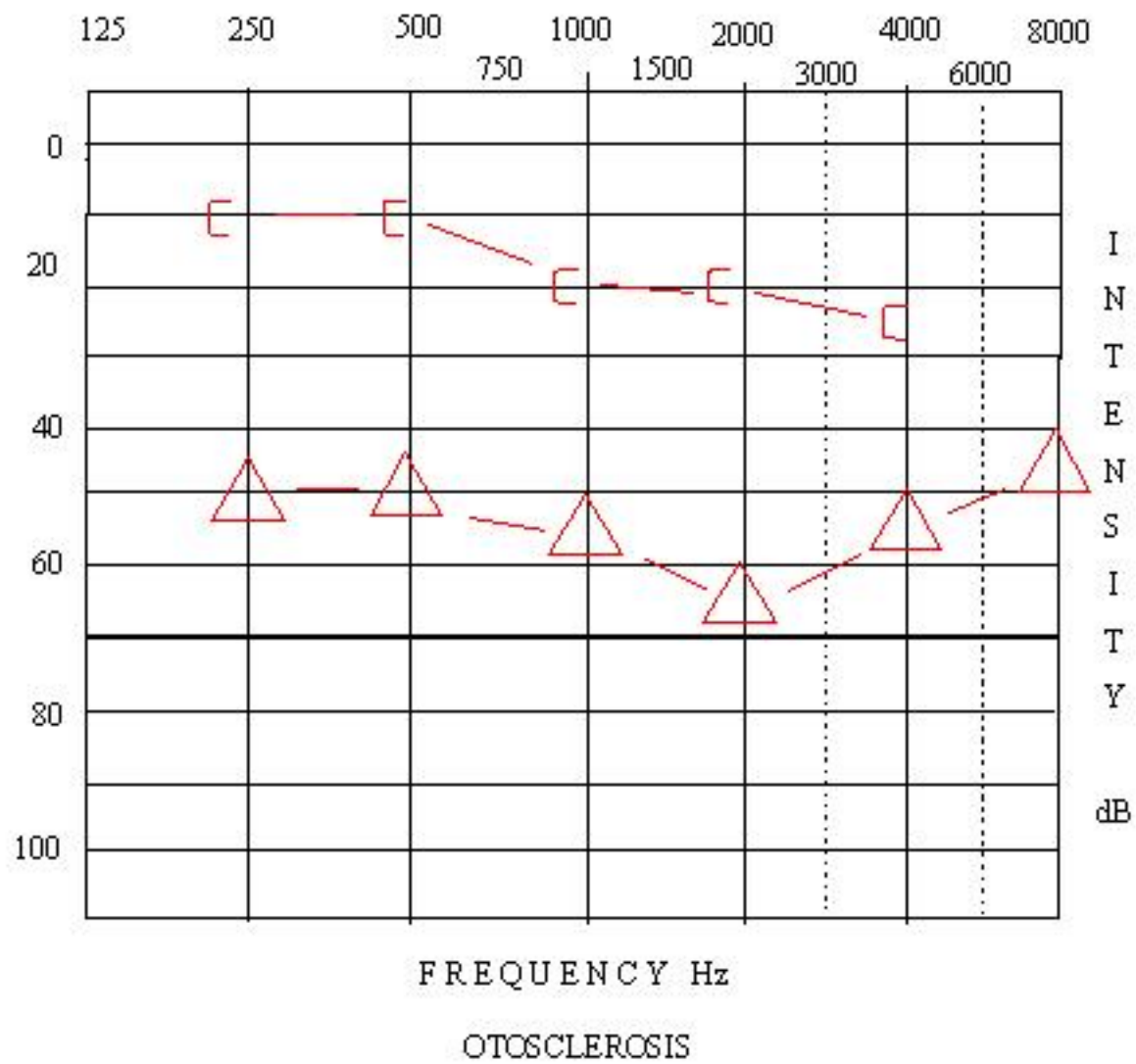


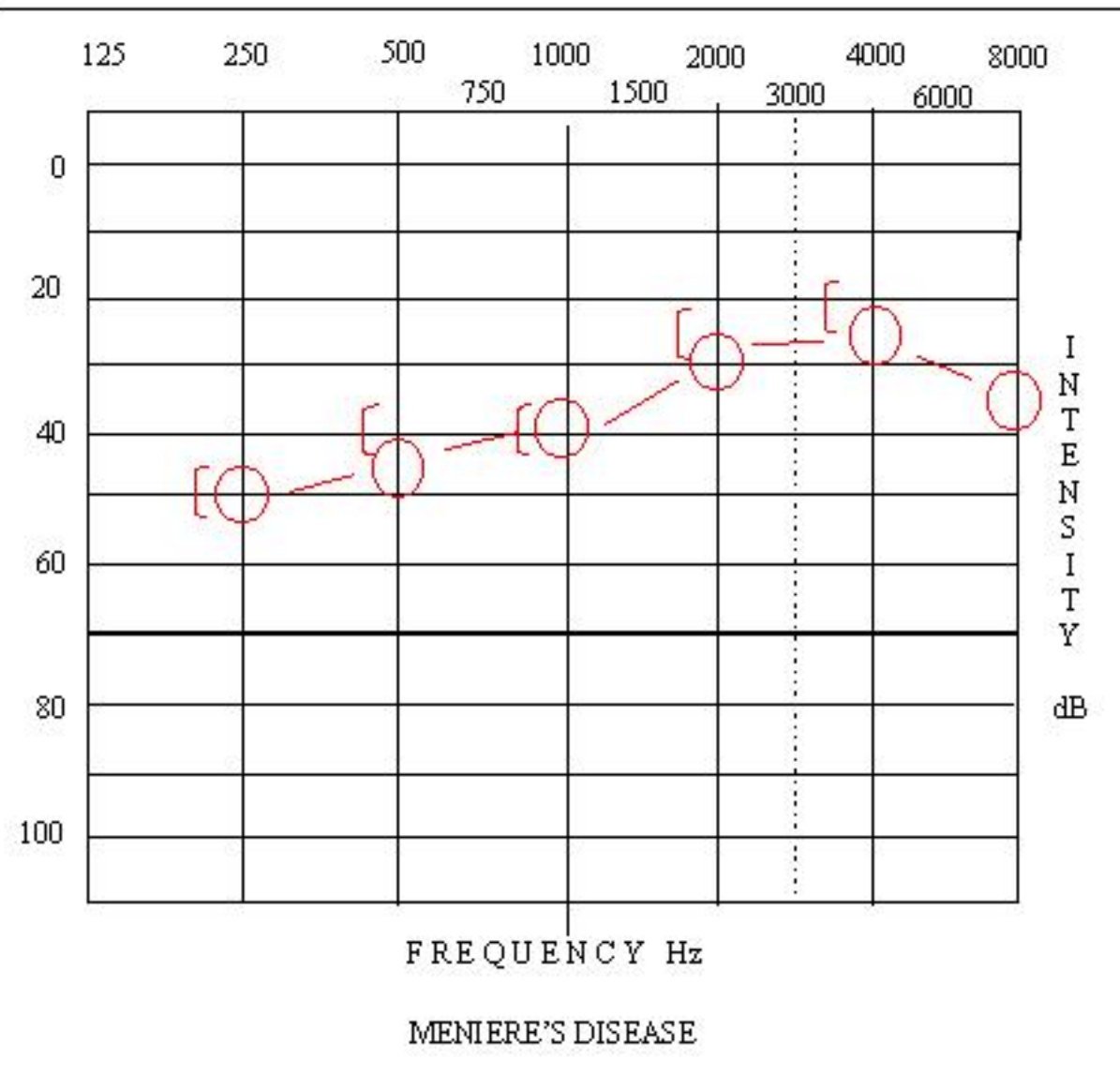
SENSORINEURAL HEARING LOSS

Key to symbols on an audiogram:

	Right	Left
Air unmasked	○	×
Air masked	△	□
Bone unmasked	<	>
Bone masked	[]
Sound field	S	S
Aided	A	A







Noise Induced Hearing Loss (NIHL)

Introduction to NIHL

- NIHL is the **second most common** form of acquired HL,
- NIHL second most frequently self reported occupational injury.
- NIHL is **a type of Sensory-Neural HL**

DDX of SNHL

- **Presbycusis:** Bilateral and symmetric SNHL
(usually the higher frequencies)
Causes: Degeneration of the cochlea, cranial nerve VIII or the central auditory system.
- **Noise-induced HL:** Temporary or permanent HL
(typically greatest in the 4000-6000 HZ)
Often Bilateral & symmetric SNHL
Cause: Secondary to cochlear damage
- **Otosclerosis:** Progressive conductive or mixed hearing loss.
Causes: Stapedial fixation in the oval window, stiffening the middle ear system.

DDX of SNHL

- **Meniere disease:** In early stages, HL is usually unilateral & fluctuant, but it develops into a permanent SNHL.
- **Sudden SNHL**
- **Infective:** meningitis, encephalitis, spirochetal infections
- **CNS disorders:** i.e: acoustic neuroma
- **Hereditary HL**
- **Metabolic disorders**
- **Non organic HL**

DID YOU KNOW.....?

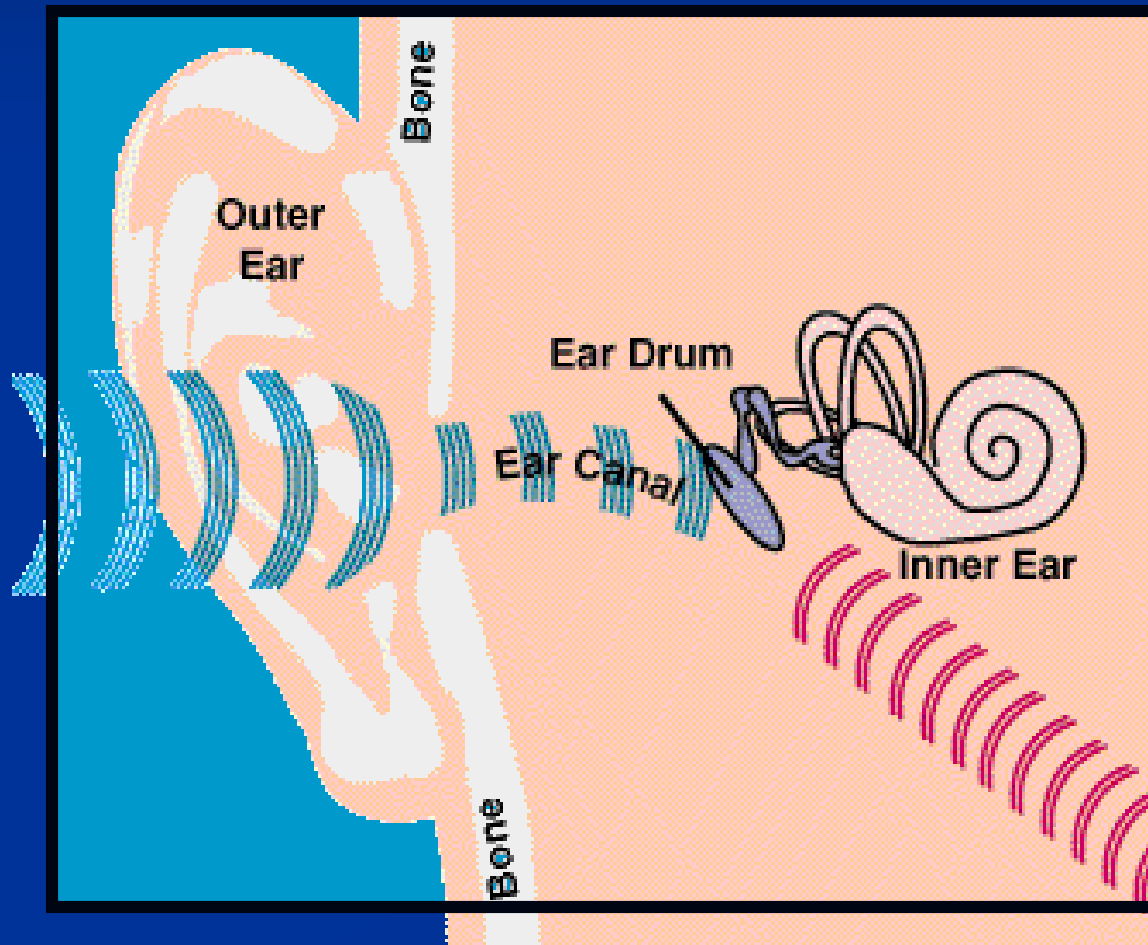
Noise-induced hearing loss:

- It is generally painless
- It is progressive over time
- It is permanent
- It is PREVENTABLE!!!

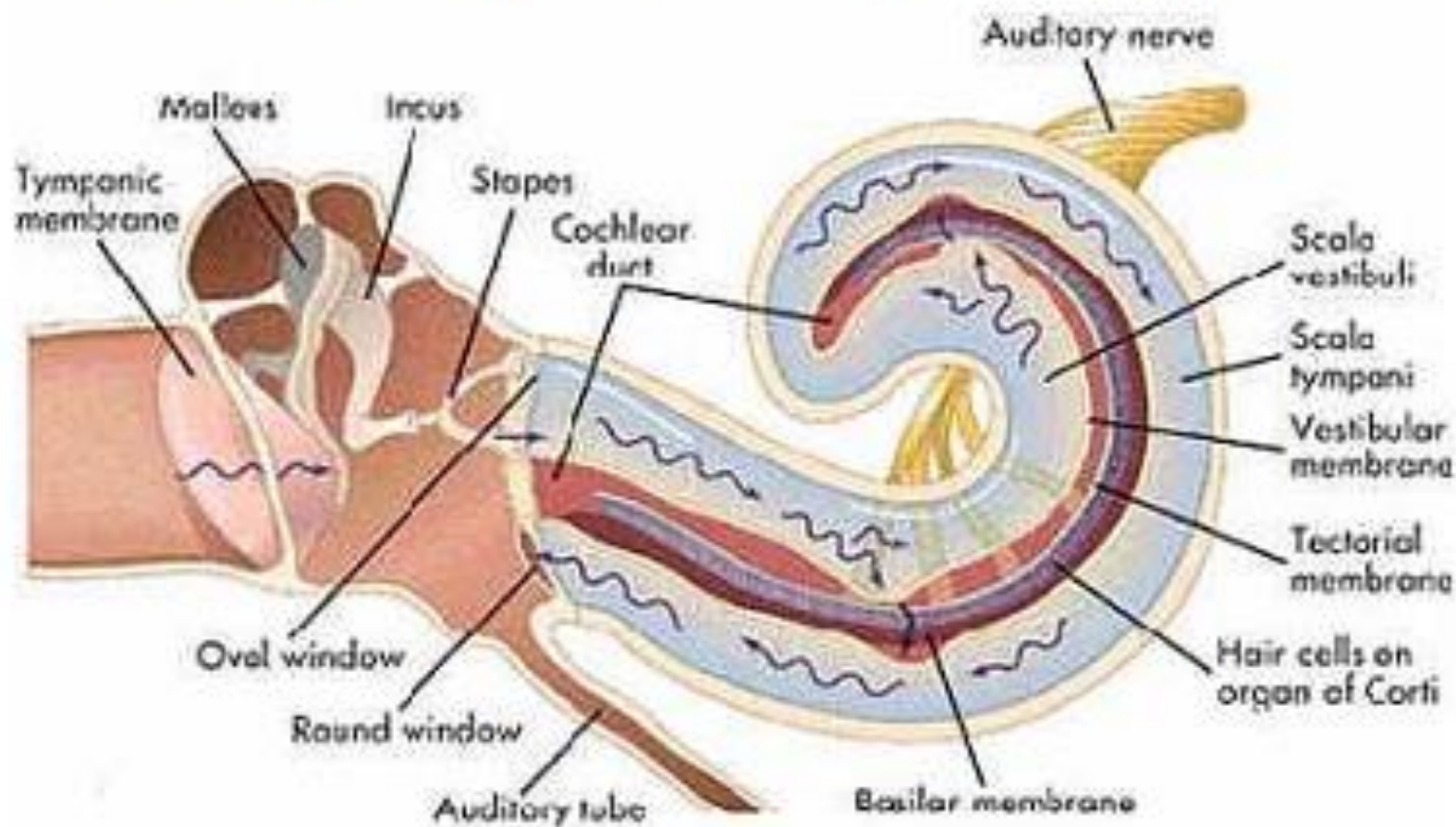


The 4 Ps

Noise Conduction



Anatomy and Physiology



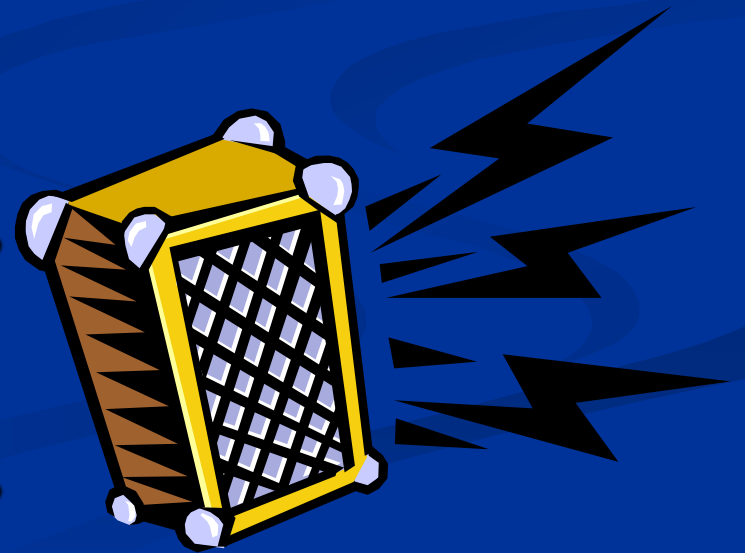
When is **noise** scientifically defined to be a **hazard**?

- Duration of exposure, intensity of sound, repeated exposure, individual susceptibility
- 85dBA for steady-state noise sources
- 140dBP for impulse/impact noise sources
(**Acoustic Trauma**)

- 130 dB: Threshold of pain
- 95 dB: Short exposure can cause permanent hearing loss. Must shout to communicate at 1 foot distance
- 90 dB: OSHA PEL. Prolonged exposure causes mild to moderate hearing loss.
- 85 dB: OSHA hearing conservation program required. Prolonged exposure causes slight hearing loss. Must shout to communicate at 3 foot distance.
- 60 dB: Normal conversation
- 0 dB: Threshold of hearing

Noise Examples

❖ Rustling Leaves	20dB
❖ Conversation	60dB
❖ Automobile	70dB
❖ Alarm Clock	80dB
❖ Screaming Child	90dB
❖ Pneumatic Drill	100dB
❖ Helicopter	110dB
❖ Live Concert	130dB



Inner Ear Pathology

Normal cochlea

Auditory-nerve fibers >



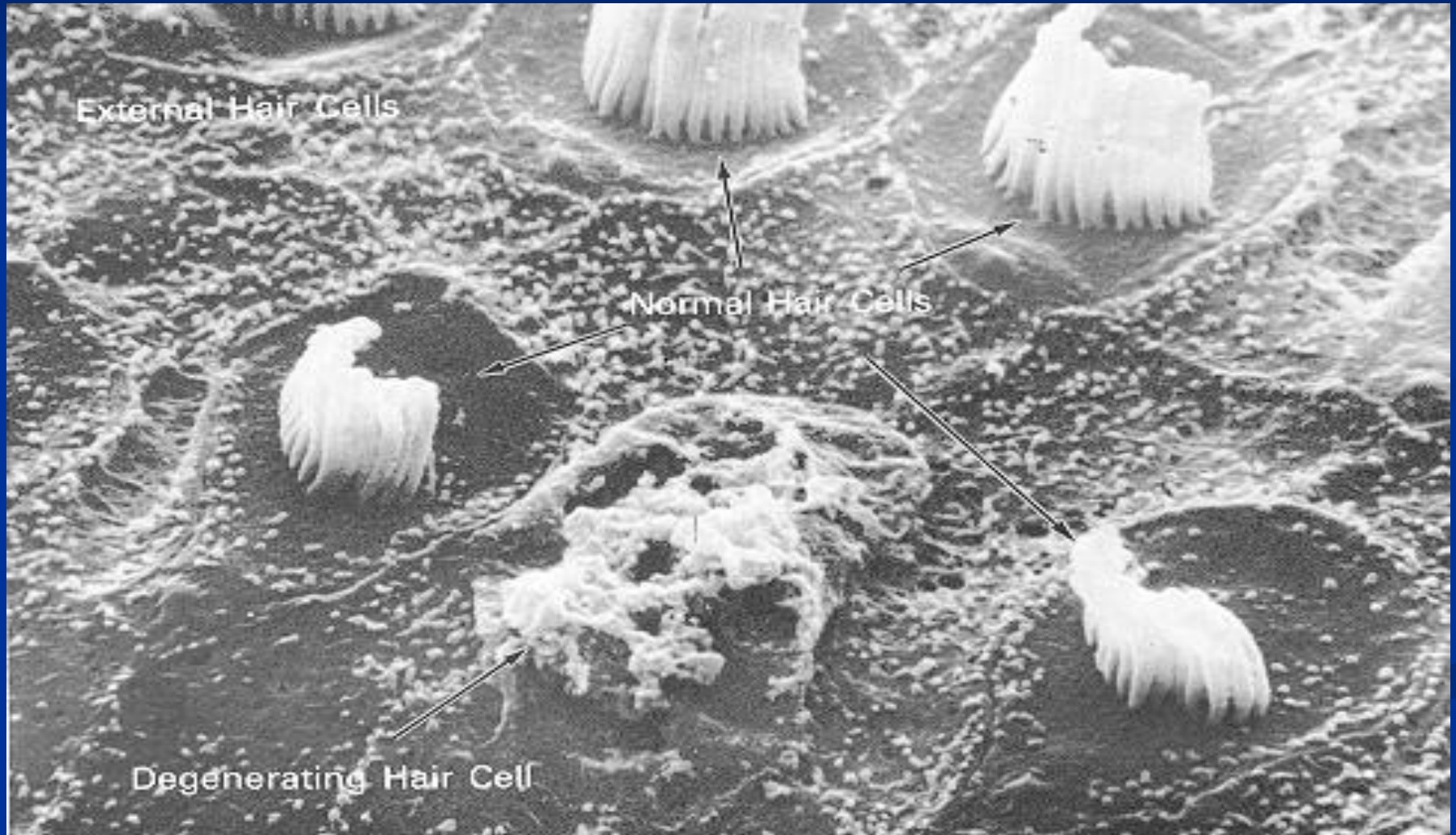
Inner Ear Pathology

Severe damage



Auditory-nerve fibers >

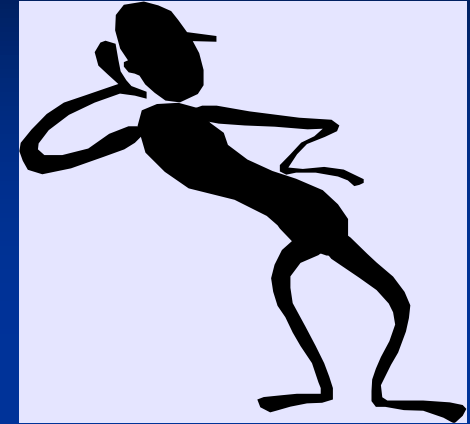
DAMAGED HAIR CELLS



How Can NIHL Happen ?

➤ ETIOLOGY :

Genetic & Environmental factors



➤ COUSES :

ACOUSTIC TRAUMA – ONE TIME EXPOSURE TO LOUD SOUND

ACOUSTIC REFLEX :

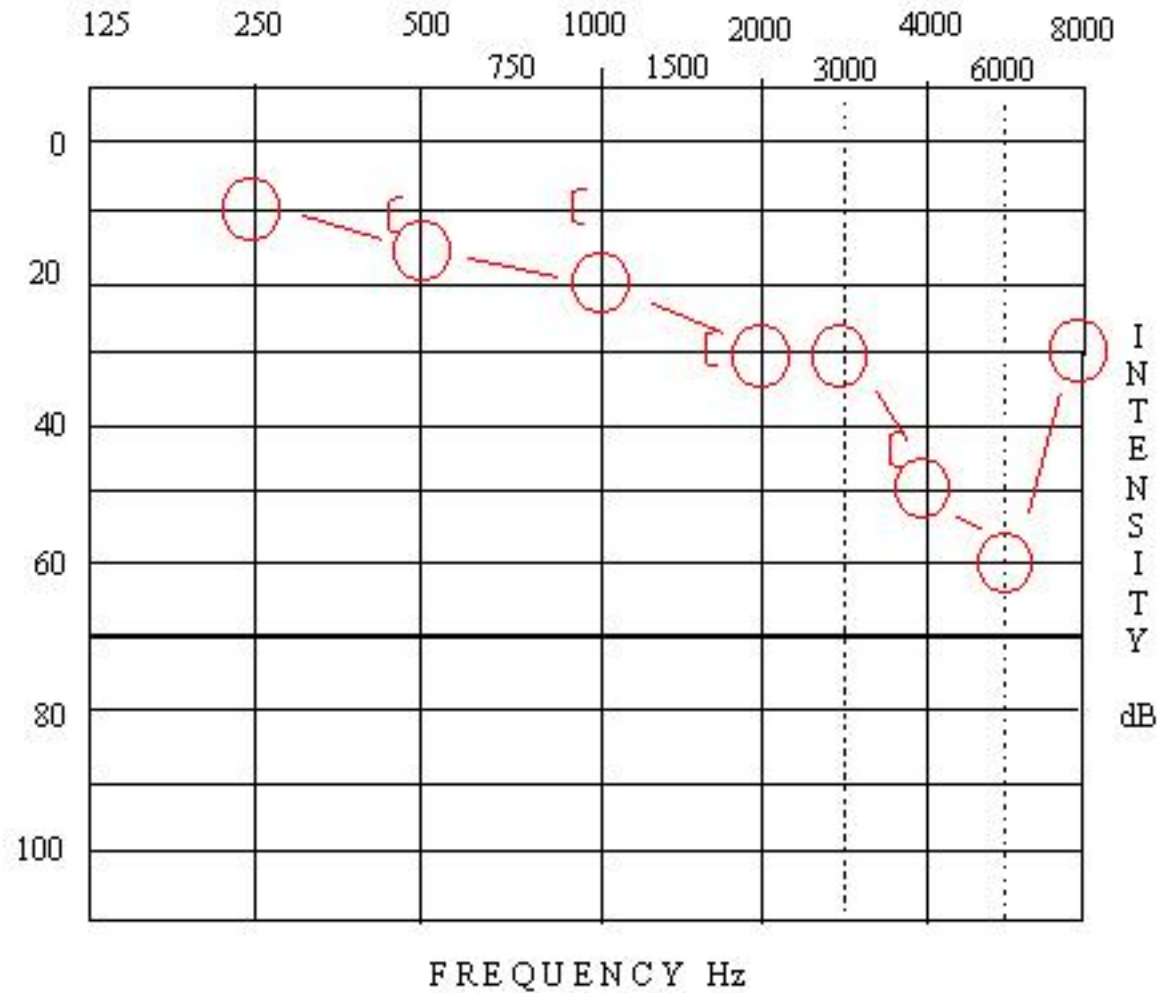
Trigger → $>90\text{db}$, (25-150ms latency) , not dampened sudden impulse noise

Risk factor of occupational NIHL

- Prolong exposure to Noise > 85 db
- Aging
- Exposure to solvent and other ototoxicants
- Smoking
- Dm
- Thyroid disorders
- Hyperlipidemia, Hypercholesterolemia

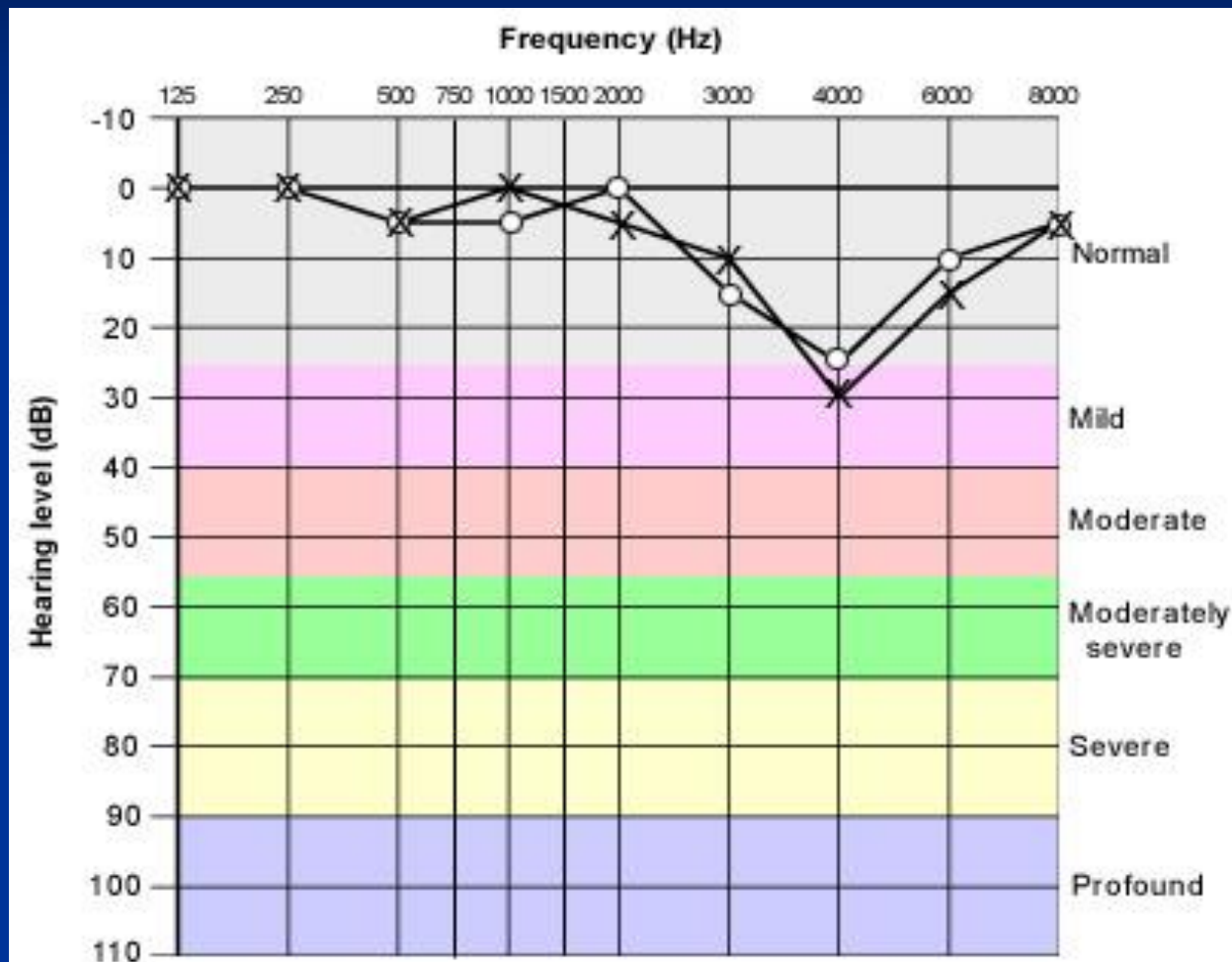
Noise Induced Hearing Loss

- Initially, exposure to noise causes a loss of sensitivity to high frequency (high pitch) sound.
- Continued exposure results in damage to mid frequency region as well.
- One can experience progressive high frequency hearing loss and not be aware of it until it becomes severe

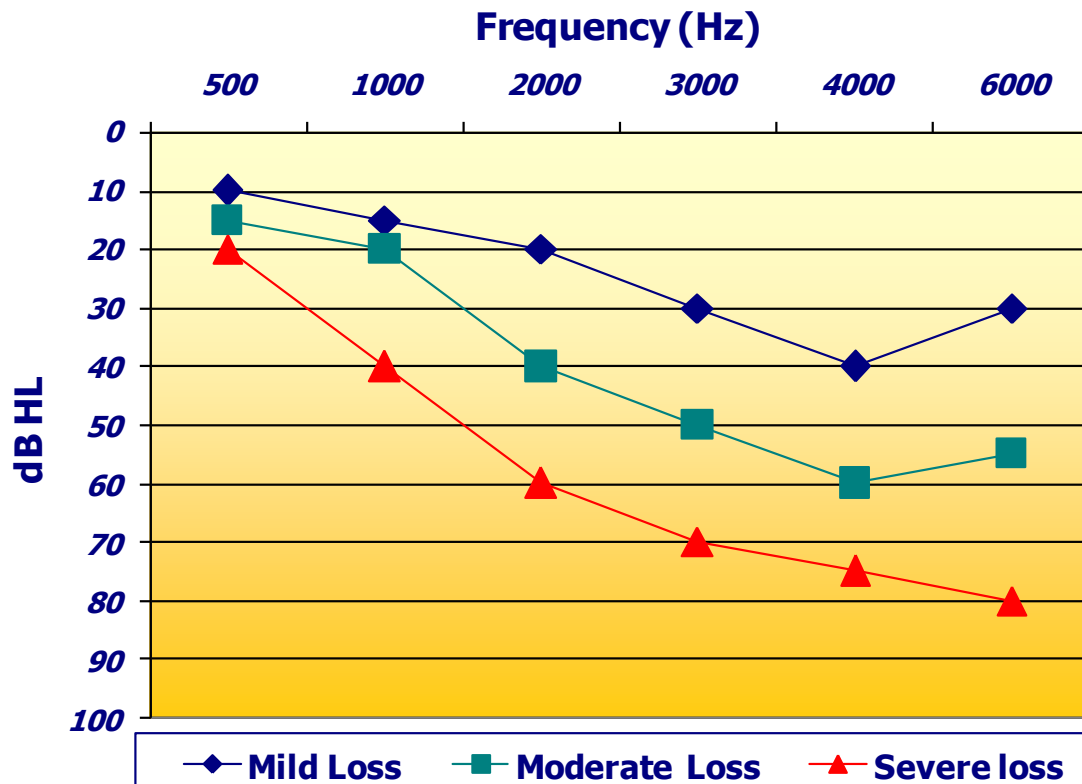


NOISE-INDUCED HEARING LOSS

NIHL



Progressive noise-induced hearing loss



Permanent Effects of Noise

- Difficulty understanding conversation, particularly in background noise...high frequency hearing loss affects ability to hear consonants.
- Quality of environmental sound is diminished.
- "Ringing in Ears" – tinnitus → Inability to fall asleep or concentrate in quiet room.

Medical Evaluation of Hearing Loss

The Role of the Physician

- History and physical exam
- Review of hearing tests and noise exposure data
- Determination of the existence of significant hearing loss
- Calculation of severity or percentage loss
- Establishment of causation and/liability

History

- Duration
- Dizziness
- Ear drainage
- Infections
- Ear surgery
- Medications
- Trauma
- Type of work performed
- Known noise exposure
- Use of hearing protection
- Noisy hobbies
- Gun fire
- Military experience
- Prior audiograms
- Family history of hearing loss

Physical Examination

- Normal or abnormal ear exam
 - External ear Canal
 - T.M.
 - Middle ear
- In general physical exam is not as important as history and audiometric data

Pure-Tone audiometry

- Primary purpose : determine the type, degree, and configuration of hearing loss.
- Other purposes: Reliability of test result, Symmetry of HL, Comparison to other tests
- This measure involves the peripheral and central auditory systems.

Hearing Loss Prevention *Program*

Components:

- Noise measurement
- Education and training
- Engineered noise control
- Hearing protection
- Posting of noise hazard areas
- Hearing tests
- Annual program review

Noise measurement

- *OSHA 8 hour permissible exposure level (PEL) for noise :*

90 (dB)

- *If worker noise exposure will equal or exceed of 85 dB, then noise monitoring is required.*

Noise measurement

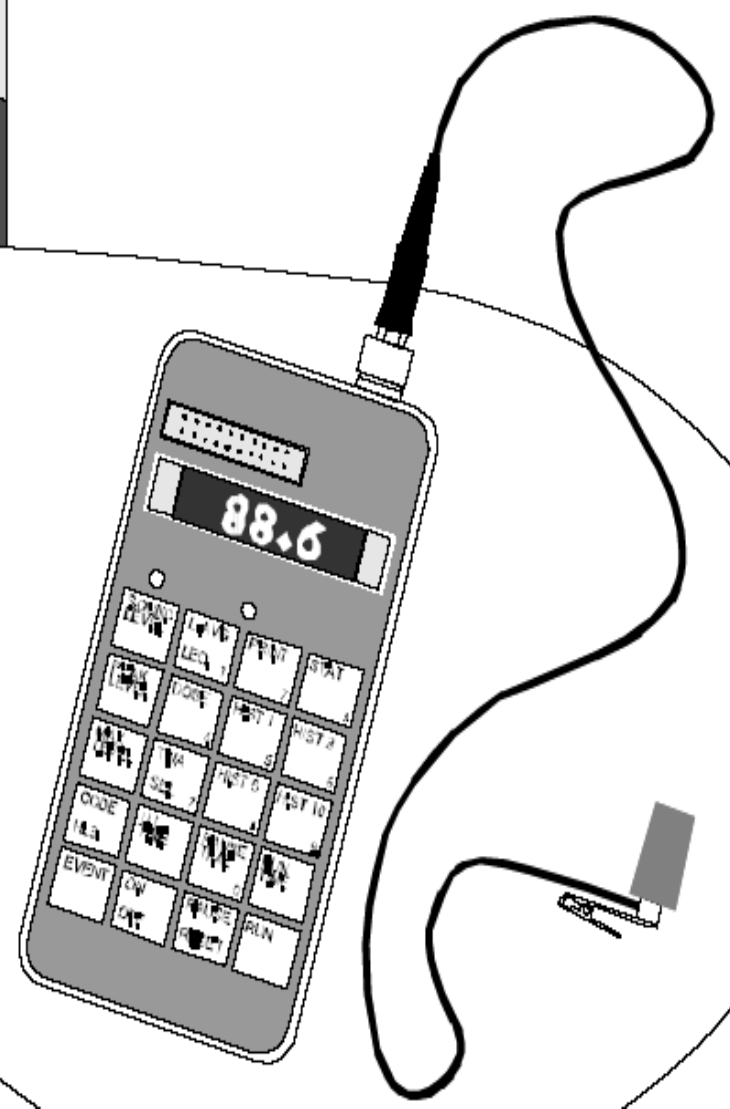
- *Noise monitoring must be characterized in term of:*
 - Frequency** (high, low or mixed)*
 - Intensity** (how loud it is)*
 - Type** (continuous, fluctuating, intermittent, or impulse)*
- The risk of hearing loss depends on the **loudness** and **frequency** of the noise, and **how long** the workers are exposed to noise and **susceptibility** of workers.

Sound level meters



Noise dosimeter



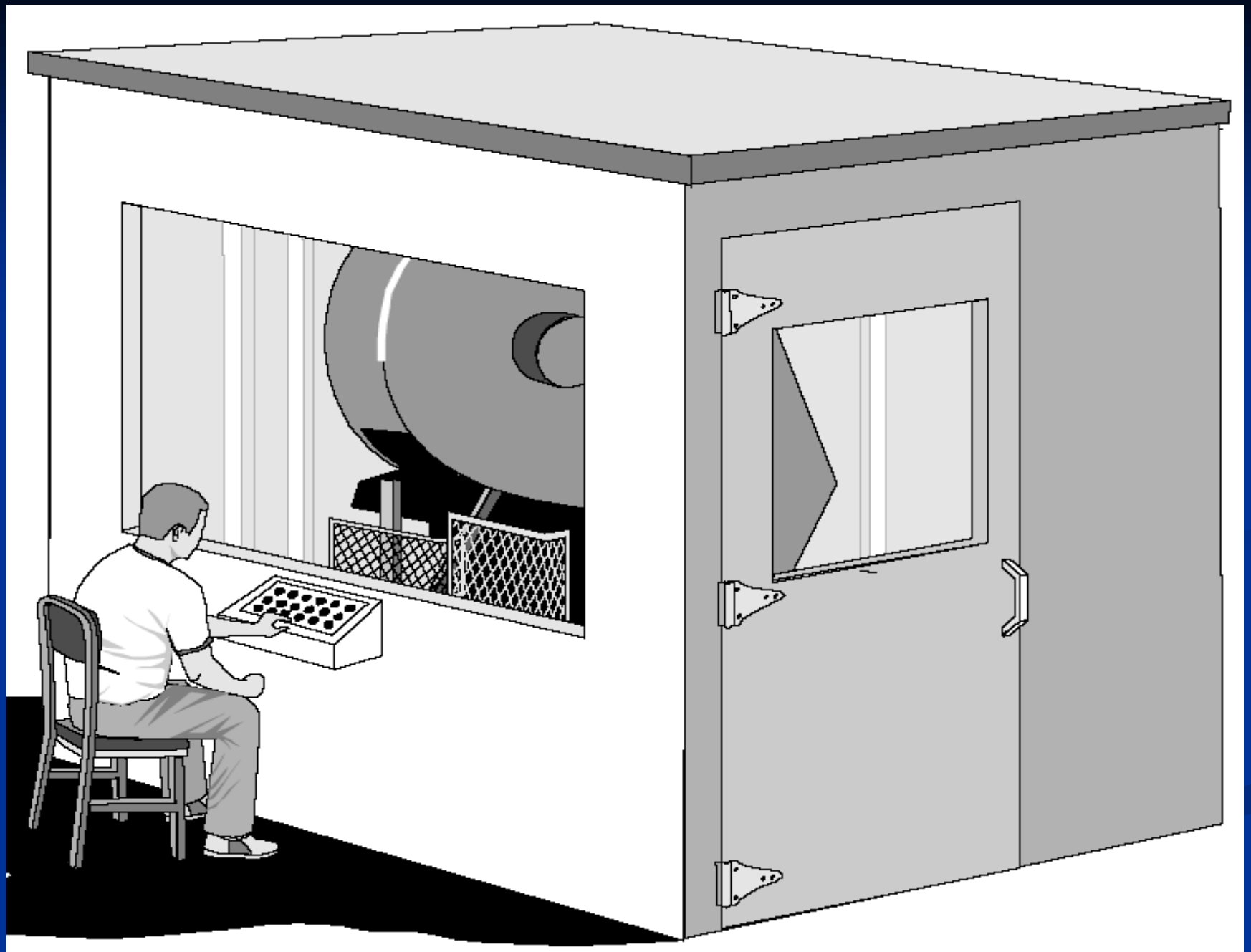


Engineering Controls

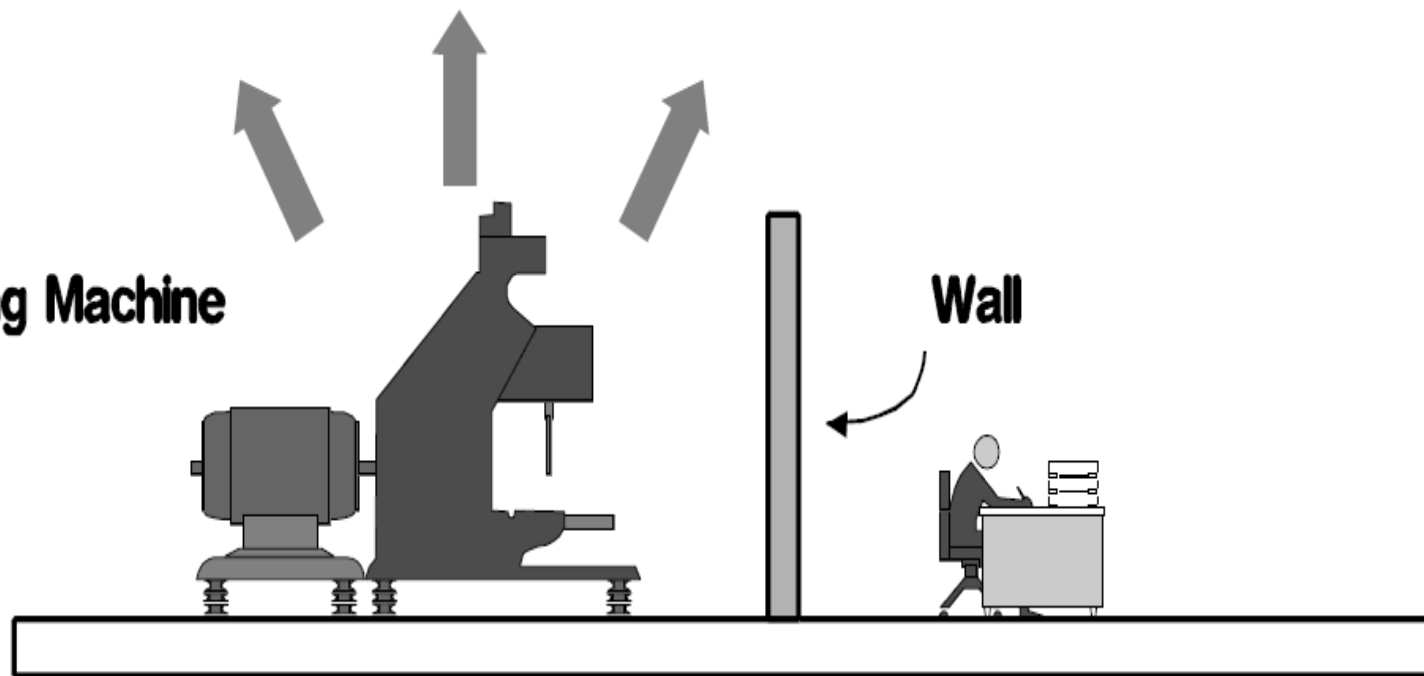
- *Source of noise*
- *Sound Pathway*
- *Receivers*

Methods

- Enclosure
- barrier
- Distance



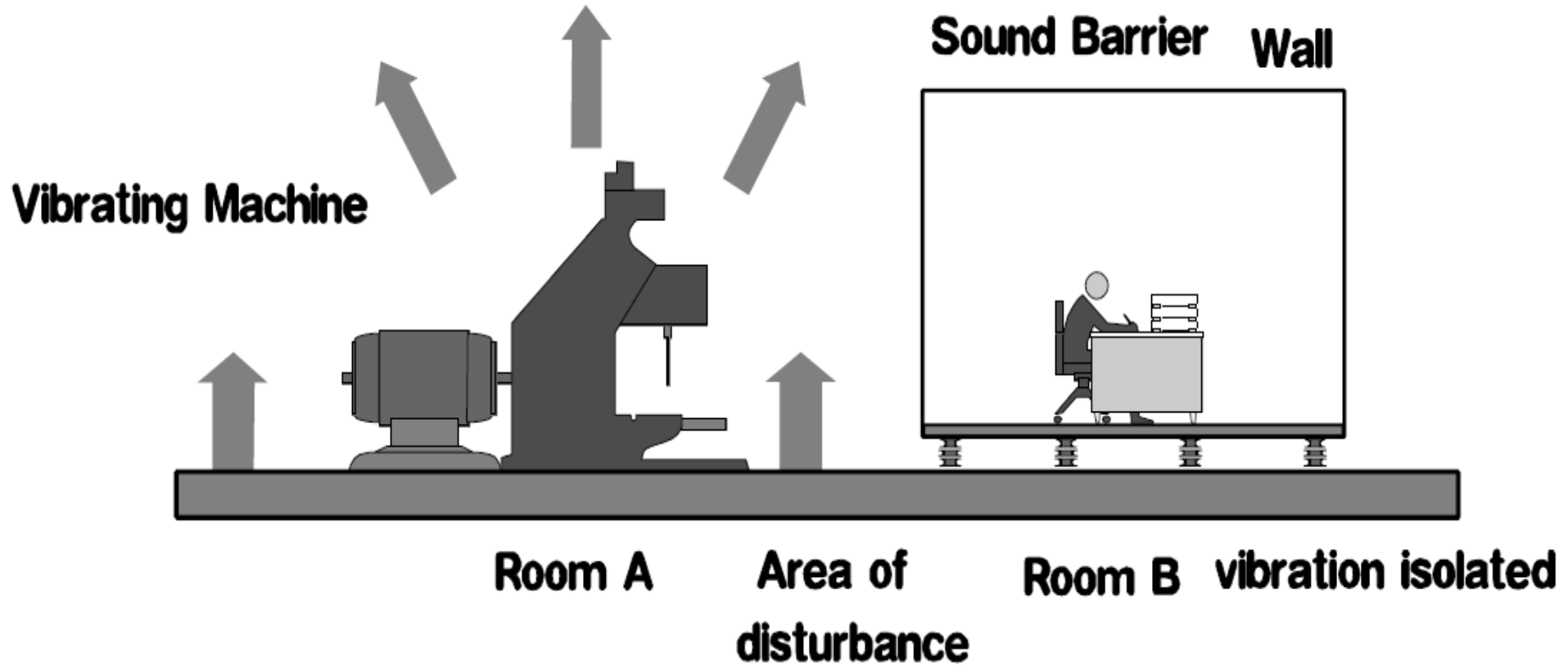
Vibrating Machine



Wall

Room A

Room B (machine vibration isolated)

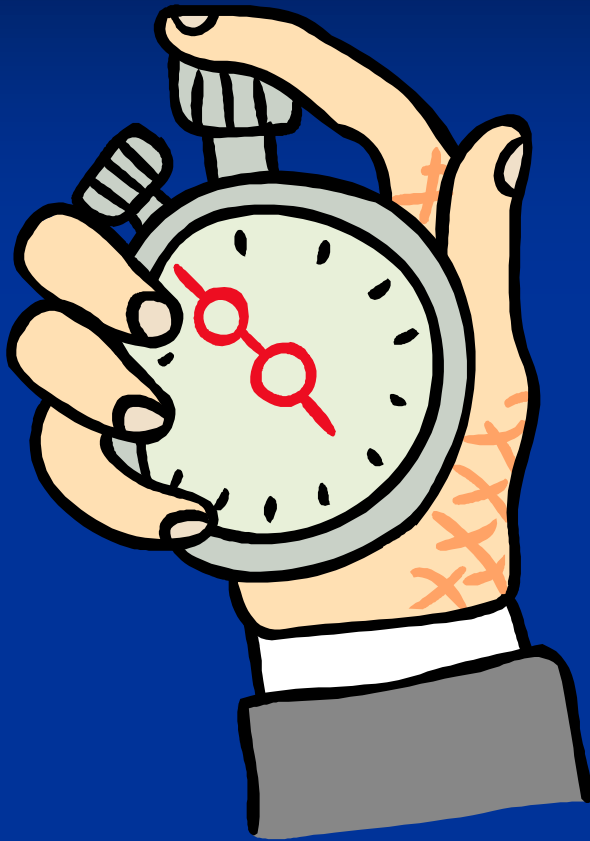


Administrative controls

- کاهش ساعات تماس کارگر با صدا جهت کاهش TWA از ۸۵ دسی بل.

- صدور دستورالعمل، جهت جلوگیری از خرید وسایلی که تولید صدای زیاد می کنند.

* این روش نیاز به موافقت مدیر سازمان و سرپرست دارد و به عنوان روش تکمیلی در HCP انجام می گردد.



Noise Level, L	Reference Duration, T
80	32.0
81	27.9
82	24.3
83	21.1
84	18.4
85	16.0
86	13.9
87	12.1
88	10.6
89	9.2
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2.0
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0

Noise Level, L	Reference Duration, T
106	0.87
107	0.76
108	0.66
109	0.57
110	0.50
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.13
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031
131	0.027



Hearing Protection

Hearing protection devices

Hearing Protection Devices

- *Use of HPDs by employee exposed to noise levels of 85 dBA or greater is recommended.*
- *HPDs MUST attenuate worker exposure to an 8-h TWA at or below 90 dBA.*

استفاده از تجهیزات حفاظت شنوایی

- انتخاب وسیله حفاظت فردی باید با توجه به صدای محیط ، مدت مواجهه ، خصوصیات فیزیکی فرد ، منقطع یا مداوم بودن صدا و... صورت گیرد .
 - زیرا در صورت عدم انتخاب درست نه تنها این وسایل هیچگونه حفاظتی به عمل نمی آورند بلکه حتی باعث وارد آمدن صدمات بیشتری می شوند چون کارگر را به خیال در امان بودن در محیط پر سروصدا حضور می یابد .
 - باید کاملاً اندازه باشد و کارگر به طور مرتب از آن استفاده کند . به طور کلی این تجهیزات به دو نوع تقسیم می گردند :
- الف: پلاک گوش (Ear Plug)** معمول ترین وسیله حفاظت شنوایی در میان کارگران است که در مجرای گوش قرار می گیرد و در فرکانسهای پائین اثر حفاظتی بیشتر دارد.
- ب: گوشه (Ear Muff)**: وسیله ای از جنس پلاستیک و لاستیک با دو صفحه بزرگ اسفنجی است که سطح گوش خارجی و لاله هر دو گوش را کاملاً می پوشاند در فرکانسهای بالا موثرتر از Ear Plug می باشد.



1. Using clean hands, roll and compress the **entire** earplug into a thin cylinder.



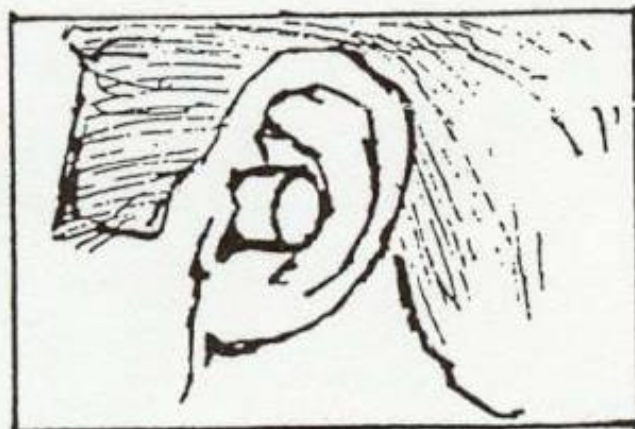
2. To make insertion easier, pull back and up on outer part of ear.



3. Insert earplug into ear canal and hold in place for a few seconds until it expands and blocks out noise.



4. Properly inserted.



5. **Not** properly inserted.

Ear Plugs

1



2



3



Straighten the ear canal before inserting the plug.

روش های نادرست استفاده از گوشه اسفنجی

هرگز گوشه اسفنجی را به شکل گروی یا مخروطی در داخل گوش قرار ندهید.

گوشه های اسفنجی یکبار مصرف بوده و در انتهای شیفت کاری باید دور ریخته شوند.



Reusable ear plugs



قرار دادن نادرست گوشی باعث کاهش قدرت حفاظت آن می شود.



۱. قبل از جا گذاری و نیز قبل از بیرون آوردن گوشی، دستها را با آب و صابون کاملاً شسته و خشک کنید.

۲. با دست مخالف، قسمت خارجی لاله گوش را به سمت بالا و عقب کشیده تا مجرای گوش کاملاً مستقیم شود.



۳. با دست موافق، دسته گوشی را در پشت بزرگترین پره، بین انگشت سبابه و شست محکم گرفته و کوچکترین پره را وارد مجرای گوش کنید. سپس با فشار تدریجی و حرکت چرخشی آهسته آن را به سمت داخل فشار داده بطوریکه بزرگترین پره مدخل ورودی مجرای گوش را کاملاً مسدود نموده و جهت دسته آن به سمت مرکز سر باشد. (مطابق شکل)

چگونه از درست قرار دادن گوشی سه لبه یا چهار لبه مطمئن شویم؟

دقت کنید که بزرگترین پره دقیقاً همسطح با مدخل ورودی مجرای گوش بوده و آن را کاملاً مسدود کرده باشد.



نگهداری نامناسب گوشی های سه لبه و یا چهار لبه باعث فزایی زود هنگام و کاهش عمر مفید آنها و در نتیجه کاهش قدرت حفاظت آنها خواهد شد بنابراین ضروری است:

- در پایان هر شیفت گوشی فود را با آب ولرم و صابون معمولی شستشو داده و اجازه دهید کاملاً خشک شود، سپس آن را در داخل محفظه مخصوص فود قرار دهید، برای شستشو از ملال ها یا مواد اسیدی یا قلیایی استفاده نکنید.
- گوشی هر فرد مخصوص همان فرد بوده و نباید به صورت مشترک استفاده شود.
- در صورت وجود عفونت یا التهاب یا ترشح غیر طبیعی از گوش، از گوشی فود استفاده نکرده و جهت بررسی بیشتر به پزشک مراجعه نمایید.

Earmuffs



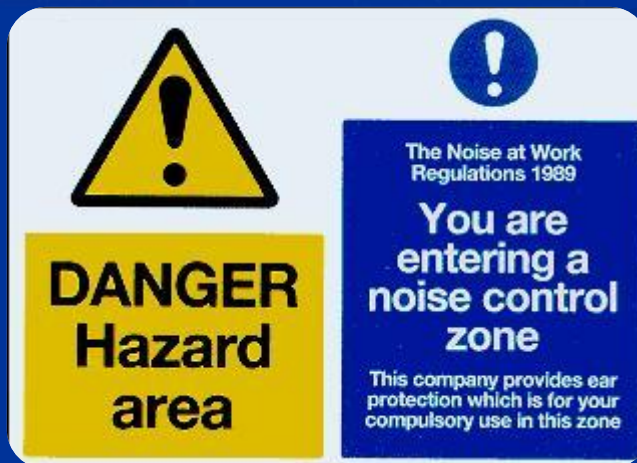
Combination : در محیط‌هایی با سروصدای بسیار شدید



Education and training

- Results of the noise survey
- Effects of noise on hearing
- Purpose of annual hearing testing
- Proper use and maintenance of hearing protection

تعدادی از پوستره‌های حفاظت در برابر صدا



HEARING TESTING

- Hearing tests are vital because they identify the beginning of NIHL before workers notice it.
- Hearing tests must be conducted annually.



OSHA 1910.95 App D

Maximum Allowable Sound Pressure Levels For Audiometric Test Rooms

➤ frequency (Hz)	500	1000	2000	4000	8000
➤ Sound pressure level (dB)	40	40	47	57	62

Audiometry

- For the baseline audiogram, the individual should not have been exposed to loud noise for at least 16 hours prior to testing.

Criteria for referral to otolaryngologist

■ Baseline audiogram:

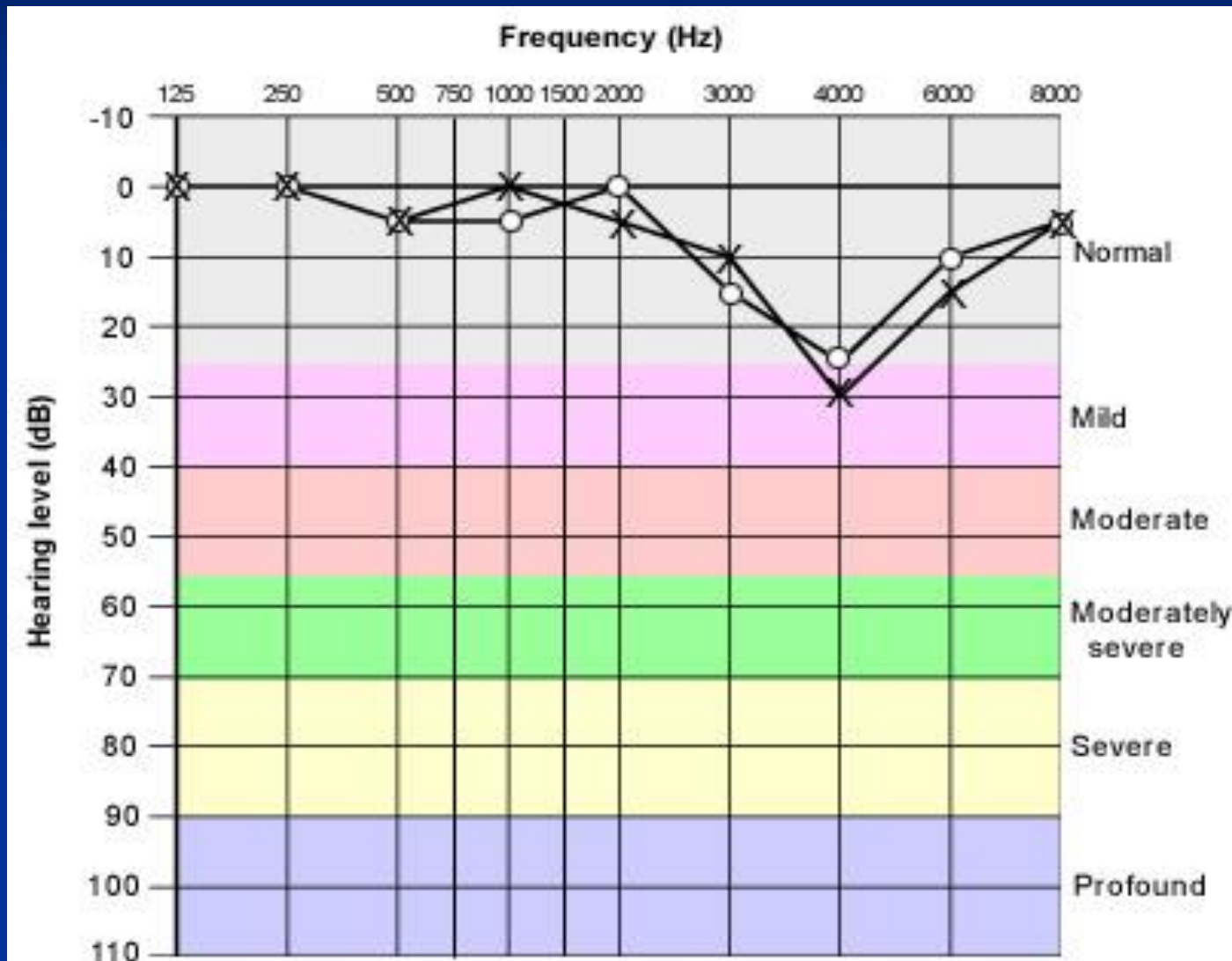
- Average HL at 500, 1000, 2000, 3000 Hz > 25 dB in either ear.
- Difference in average HL between the better and poorer ears > 15 dB at 500, 1000, and 2000Hz or > 30 dB at 3000, 4000, and 6000.

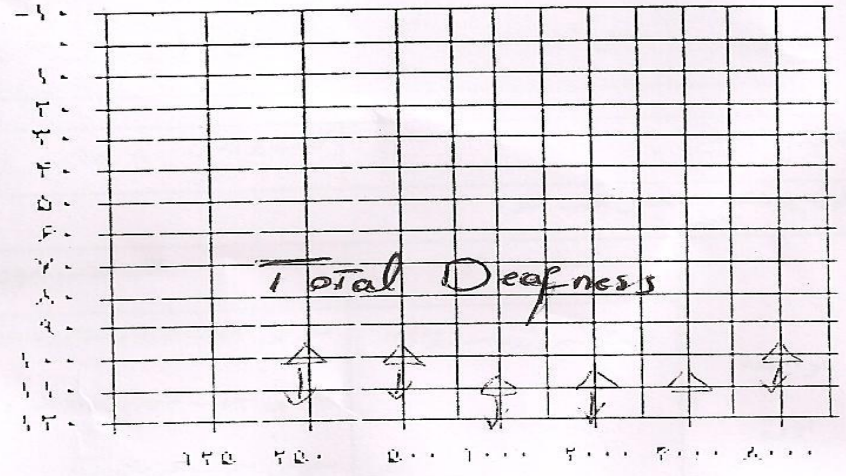
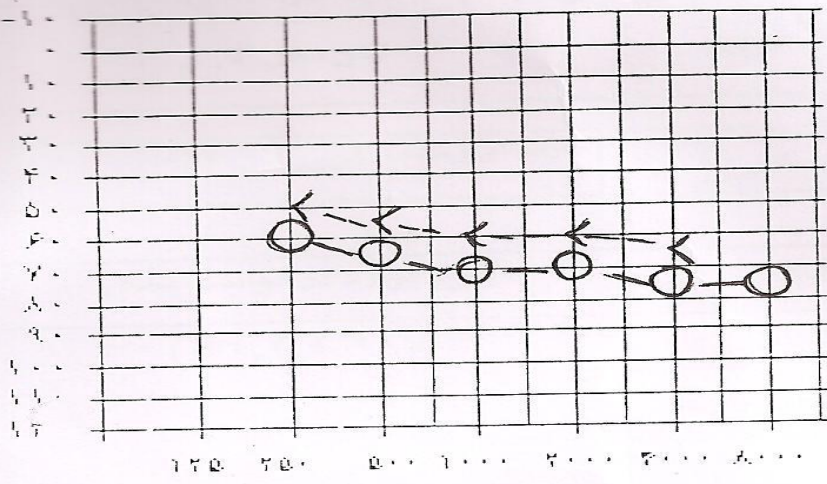
■ Periodic audiogram:

- change for the worse in average HL in either ear compared to the baseline audiogram > 15 dB at 500, 1000, 2000Hz or > 20 dB at 3000, 4000, and 6000 Hz.

■ Other criteria: ear pain, drainage, dizziness, tinnitus, fluctuating or rapidly progressive hearing loss, and ...

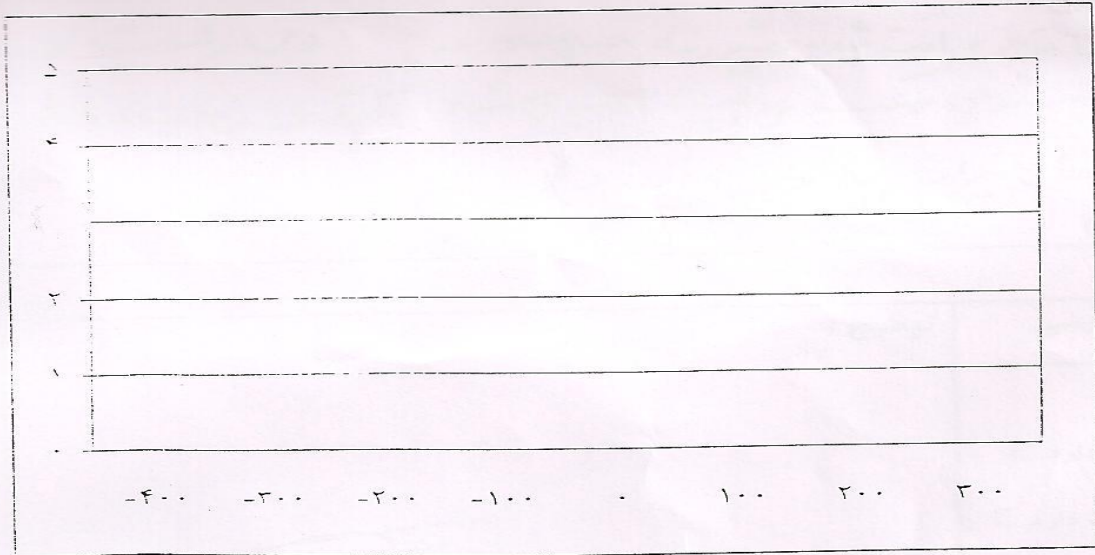
Audiometry





SRT: 70 dB
MCL: 100 dB
SDS: 90%

SRT: _____
MCL: _____
SDS: _____



Dear Dr.
Using Hearing Aid is
necessary for Right ear.

ACOUSTIC REFLEXES

FREQ IN Hertz	PROBE IN R		PROBE IN L	
	IPSI	CONTRA	IPSI	CONTRA
500				
1000				
2000				
4000				

Right

Left

Type
Static Compliance
Middle Ear Pressure(dapa)

حمیدرضا رضایی
کارشناس شنوایی
نظام بنیاد

Hearing Loss due to other Occupational Hazards

Ototoxic Hearing Loss

■ Organic solvents

- Toluene (printing)
- Xylenes (plastics)
- Styrenes (plastics)
- Trichloroethylene (degrease)
- Carbon Disulfide (textile)
- Stoddard/white spirits
- N-hexane
- Ethyl benzene
- Perchloroethylene
- Butyl Nitrite
- Methylene chloride

■ Metals

- Mercury and derivatives
- Lead and derivatives
- Arsenic (atoxyl)
- Manganese
- Trimethyltin (organic tin)
- Cobalt

■ Asphyxiants

- Carbon Monoxide
- Cyanide

■ Drugs

- Aminoglycosides
- Loop diuretics
- Anti-neoplastic agents
- ASA
- Quinine compounds

■ Others

- warfare nerve agents
- Organophosphate (pesticide)
- Paraquat (pesticide)

Ototoxic Hearing Loss

- Sensorineural Hearing Loss - Inner Ear
 - Testing: common audiometric procedures (Pure tones, Speech, Other)
- Central/Retrocochlear Hearing Loss - Brainstem and Cortex

Other causes of HL

■ Head trauma and temporal bone fractures

- 80% longitudinal: direct blow to the lateral skull, pass through the ear canal and the middle ear but bypass the inner ear structures, CHL
- 20% Transverse fractures: intense blows to either the occipital or a direct frontal blow

■ Slag burn and penetrating trauma to TM

- CHL

■ Radiation-induced hearing loss

- SNHL, This appears to be a direct result of radiation injury to the cochlea

