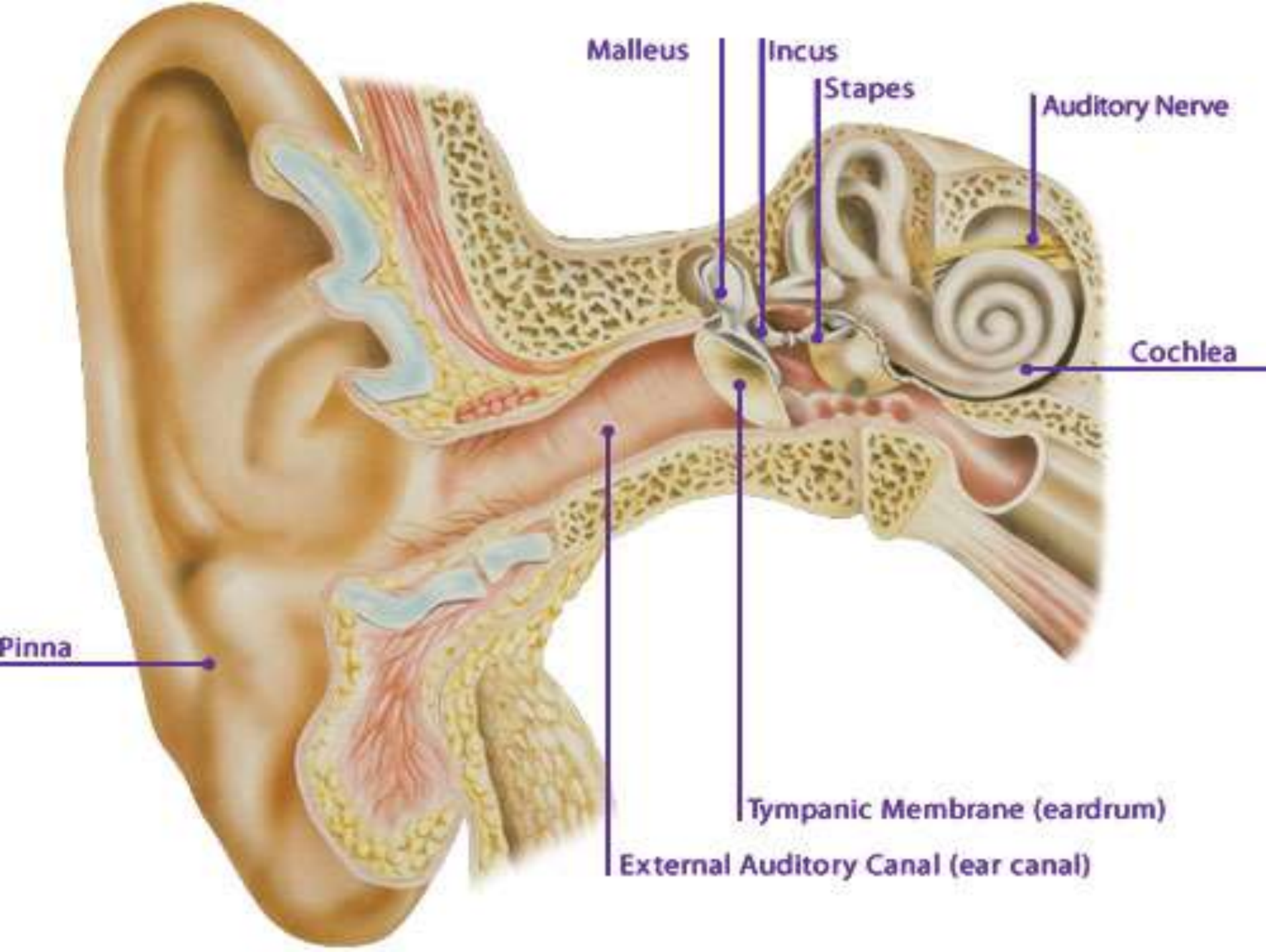


A TOOLBOX OF HEARING LOSS PREVENTION STRATEGIES....

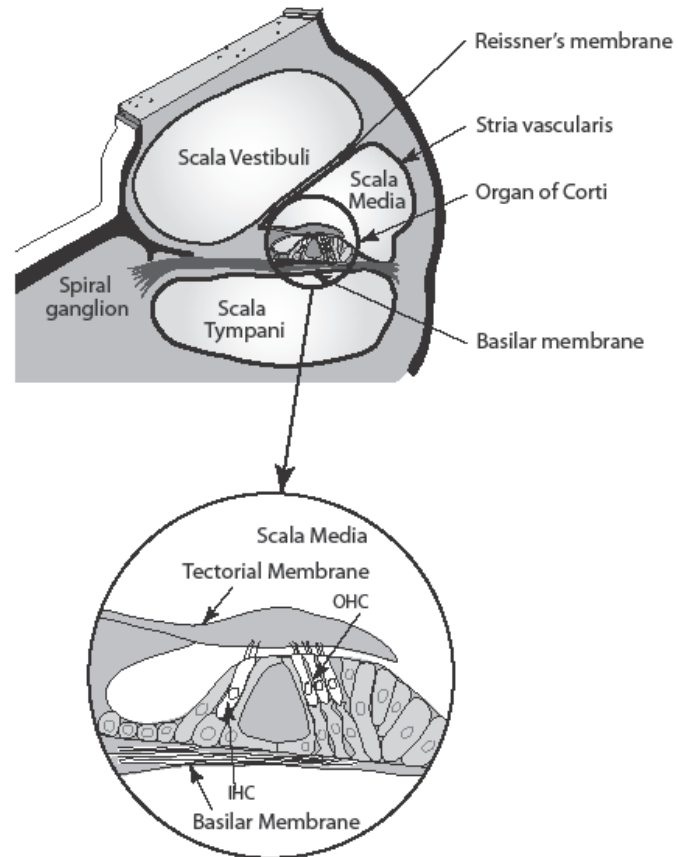
DR. MARSHALL CHASIN

MUSICIANS' CLINICS OF CANADA





THE COCHLEA (INNER EAR)



A SOUND LEVEL METER



“.... OH, JUST ONE MORE THING...”

... ipods and hearing loss



THE 80/90 MP3 RULE

The Fligor Rule (2009):

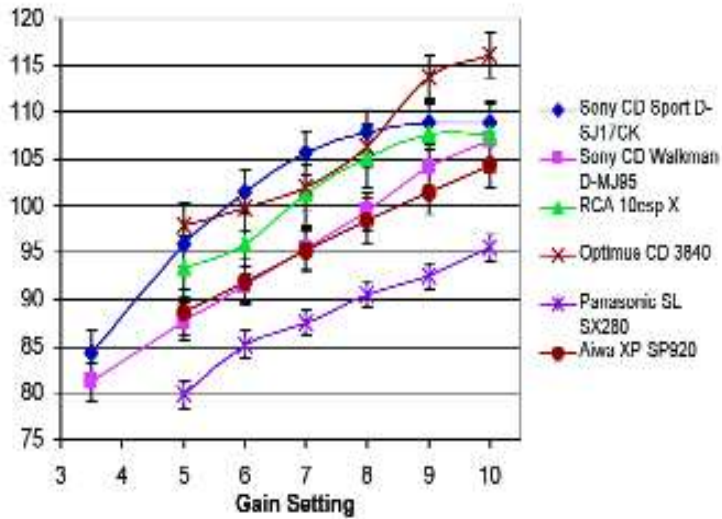
Maximum settings to obtain 50% maximum dosage...

MP3 volume at 80% for 90 minutes

Depends on earphone used

- Some earphones “isolate” the ear.
- Some earphones have different electro-acoustic characteristics.

FLIGOR (2006)



ISOLATOR EARPHONES





ZOGBY INTERNATIONAL (MARCH '06)

69% would turn down the volume

42% would listen less often

36% would use special (isolator) earphones



BEWARE OF TRUCKS COMING UP BEHIND YOU...



SO ...

- * 80/90 rule for MP3 players
- * Use isolator earphones, moderation, and listen less often
- * BUT watch out for traffic!

HOW LOUD?

Noise exposure is “almost like music exposure”

We know from factory noise exposure that 85 decibels (dBA) will eventually cause a permanent hearing loss

3 DB EXCHANGE RATE...

85 dBA for 40 hours/week

88 dBA for 20 hours/week

91 dBA for 10 hours/week

94 dBA for 5 hours/week

97 dBA for 2.5 hours/week

...



DOSIMETER



WHAT IS 85 DECIBELS?

Soft Rock



WHAT IS 85 DECIBELS?

Telephone dial tones



WHAT IS 85 DECIBELS?

MP-3 player on ½ volume...



WHAT IS 85 DECIBELS?

Toilet flushing (with head in the bowl)



TWO RULES OF THUMB...

1. If your ears ring after an activity, don't do that (without earplugs)
2. If your hearing is muffled after an activity, don't do that (without earplugs)

JANSSON AND KARLSSON (1983)

Maximum limits for symphony orchestras are achieved at anywhere between 10 and 25 hours per week of playing.



CHASIN AND CHONG (1991)

Levels in excess of 85 dBA were measured even during a relatively quiet etude at Canada's National Ballet with a peak level of 126 dBA.



Regular ballet class at The Royal Ballet School
where the young girls are the spirit of ballet.

MAXIMUM LEVELS FOR INSTRUMENTS

(WAGNER RING CYCLE: CAMP AND HORSTMAN, 1992)

<i>Instrument</i>	<i>Peak Level (dB SPL)</i>
French Horn	107
Bassoon	102
Trombone	108
Tuba	110
Trumpet	111
Violin	109
Clarinet	108
Percussion	>120
(Amplified Guitar	>115)

CHASIN (2006)

Musical Instrument (at 3 meters)*	dB [A-weighted]	dB SPL (peak)
Normal piano practice	60-90	105
Loud piano	70-105	110
Keyboards (electric)	60-110	118
Vocalist	70-85	94
Chamber music (classical)	70-92	99
Violin/viola (near left ear)	85-105	116
Violin/viola	80-90	104
Cello	80-104	112
Acoustic bass	70-94	98
Clarinet	68-82	112
Oboe	74-102	116
Saxophone	75-110	113
Flute	92-105	109
Flute (near right ear)	98-114	118
Piccolo	96-112	120
Piccolo (near right ear)	102-118	126 [†]
French Horn	92-104	107
Trombone	90-106	109
Trumpet	88-108	113
Tympani and Bass drum	74-94	106
Percussion (high hat near left ear)	68-94	125
Amplified guitar (on stage using ear-monitors)	100-106	118
Amplified guitar (on stage with wedge monitors)	105-112	124
Symphonic music	86-102	120-137
Amplified rock music	102-108	140+
Portable music (eg, iPod) in ear canal (vol = 6)	94	110-130**
iPod in ear canal (vol = full)	105	110-142**

***WITH MUSICIANS, HEARING LOSS IS NOT AS
SIGNIFICANT AS ...***

Tinnitus

Pitch perception problems



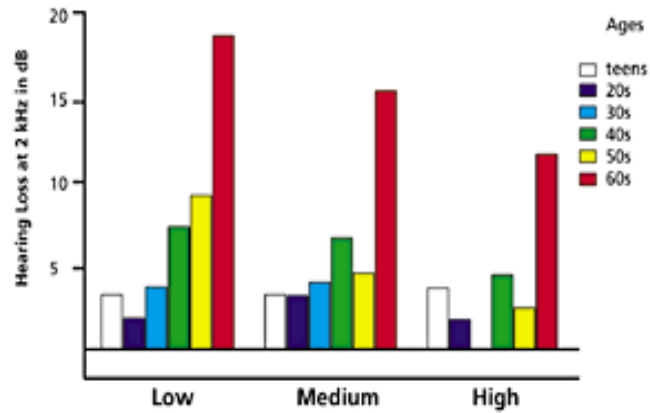
EFFECTS OF PHYSICAL FITNESS AT 4000 HZ

(ALESSIO ET AL., 2002)

<i>Age/Fitness</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>Teens</i>	2.0	2.2	0.75
<i>50-60</i>	13.5	11.3	13.0
<i>60-80</i>	34.5	21.2	14.2

ALESSIO AND HUTCHINSON, 2003

(2000 HZ)



DAMAGE TO THE COCHLEAR HAIR CELLS...

Reactive Oxygen Species (ROS) is a metabolic by-product of cells. High noise levels can cause toxic amounts of ROS.

Anti-oxidants may mitigate the ROS and minimize hearing loss from loud noise.

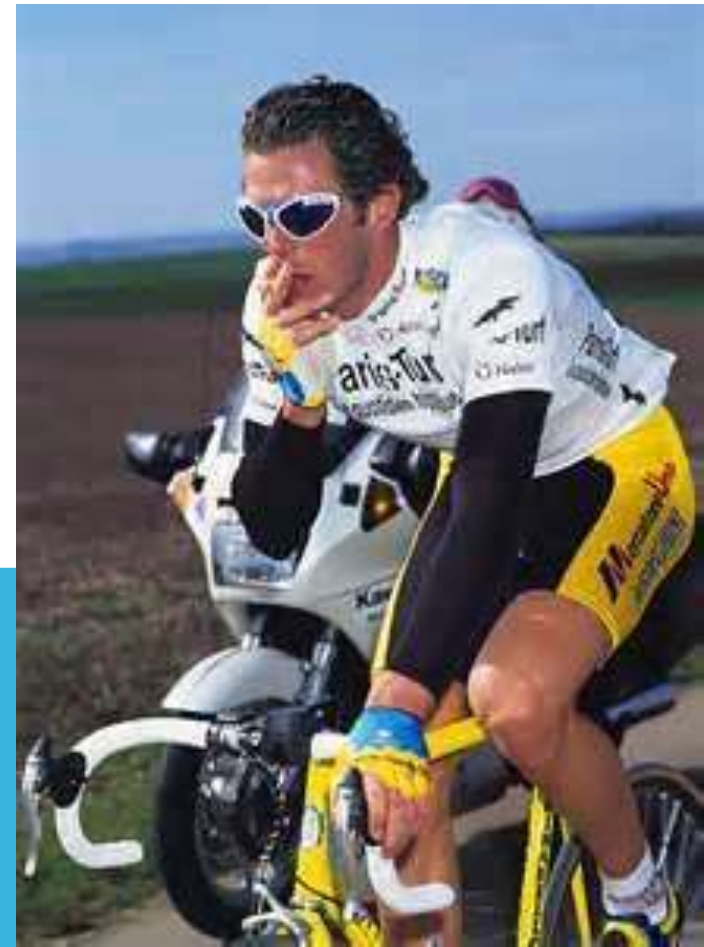
L-NAC is an anti-oxidant.



BIOCHEMICAL THINGS AND HEARING LOSS

Smoking and exercise:

-availability of oxygen in the inner ear



BIOCHEMICAL THINGS AND HEARING LOSS

Disliking music and stress:

-cortisol.... Glutamate.... ototoxicity



CAFFEINE AND NOISE EXPOSURE

:Association of Caffeine and Hearing Recovery After Acoustic Overstimulation Events in a Guinea Pig Model”. Zawawi et al.

JAMA Otolaryngol Head Neck Surg. 2016 Apr
1;142(4):383-8. doi: 10.1001/jamaoto.2015.3938.

CAFFEINE AND NOISE EXPOSURE

Guinea pigs who were exposed to both caffeine and noise exposure had greater TTS as measured by ABR, and less recovery than those who were only exposed to noise.

..... Don't visit Starbucks before going to a concert?....



PRIOR TO 1988...



HEARING PROTECTION ALTERNATIVES

(AFTER 1988)

ER-15: (1988+, Etymotic Research)

Custom made uniform attenuator provides 15 dB of attenuation up to 8000 Hz. It uses an element that interacts with an inductance to provide a 3000 Hz resonance, thus off-setting the loss of the ear canal resonance.

ER-25: (1992+)

Custom made uniform attenuator provides 25 dB of attenuation up to 6000 Hz.



HEARING PROTECTION ALTERNATIVES

ER-9:

Custom made uniform attenuator provides 9 dB of attenuation.

ETY plugs (ER-20 XS)

**Non-custom earplug with a slight high-frequency roll-off.
Costs about \$10-\$12.**



ER•20^{XS}
High-Fidelity Earplugs



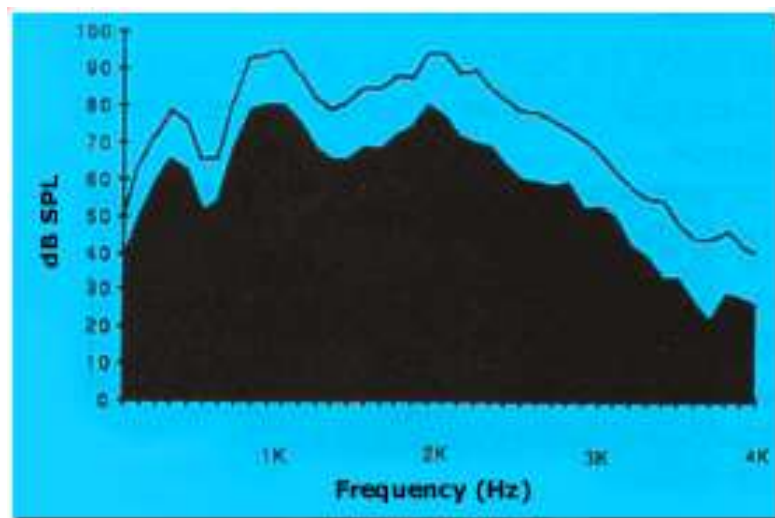


Fig. 1. Spectrum of violin playing A4 (440 Hz) without (top) and with (shaded) the ER-15 earplug. (Reprinted with permission from Chasin and Chong)

BASS SHAKERS



IN-EAR MONITORS

These are either:

Custom (Futuresonics, Sensaphonics, Westone,
Ultimate Ears, ...)

Or

Non-custom (ER-4, ER-6, Shure, Sennheiser ...)

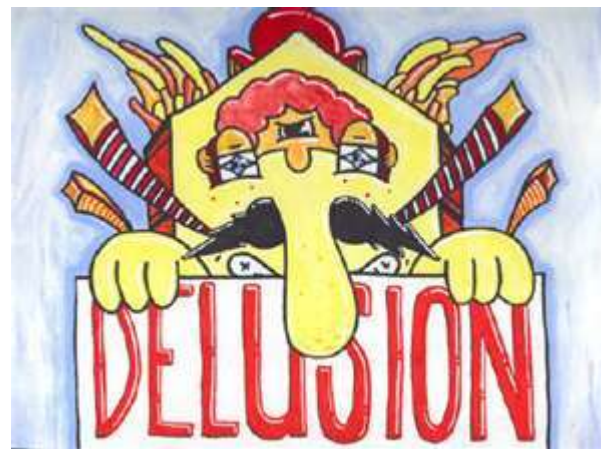


© Westone Laboratories, Inc.



INTENSITY VS. LOUDNESS

Our role as hearing health care professionals is to “delude” the musician into thinking that the music is sufficiently loud, but at a lower intensity level.



THE MANTRA....

Improved monitoring

- * Bass increase
- * Shakers (ultra-low frequency woofers)
- * In-ear monitors
- * Acoustic monitors

TEMPORARY (TTS) AND PERMANENT (PTS) HEARING LOSS

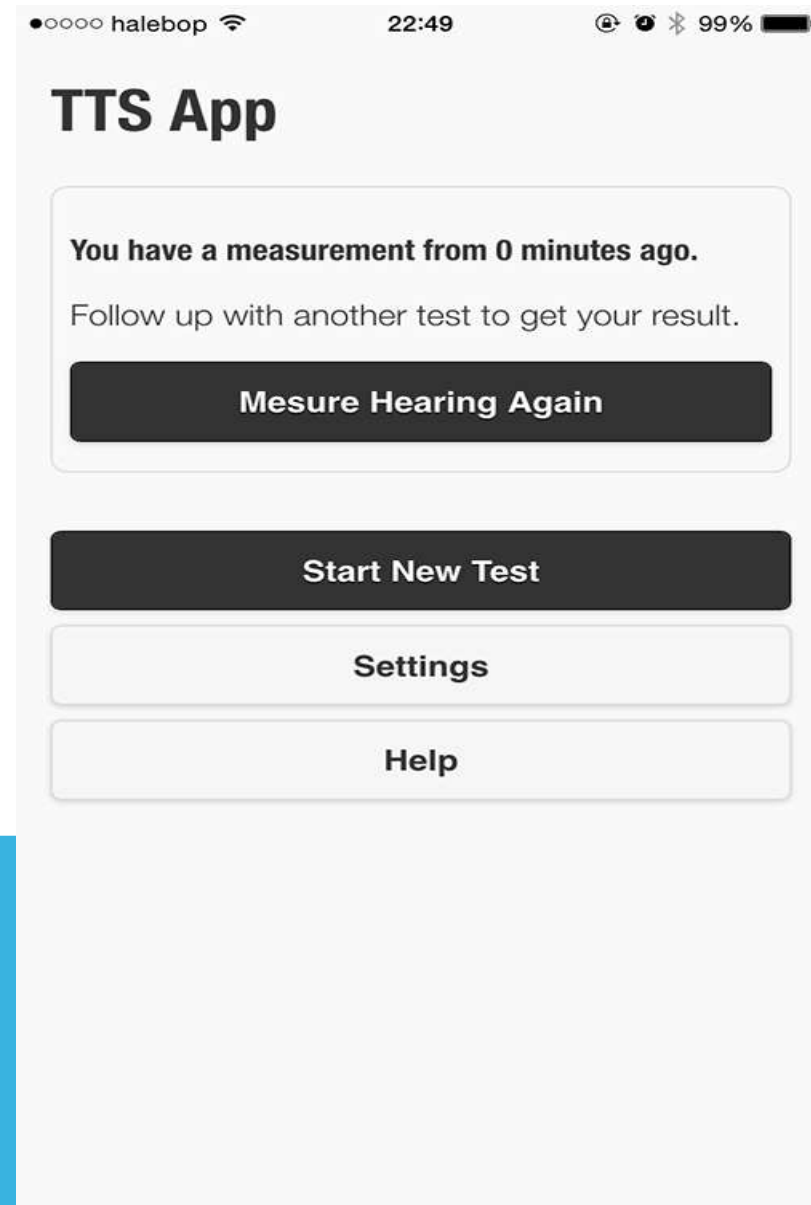
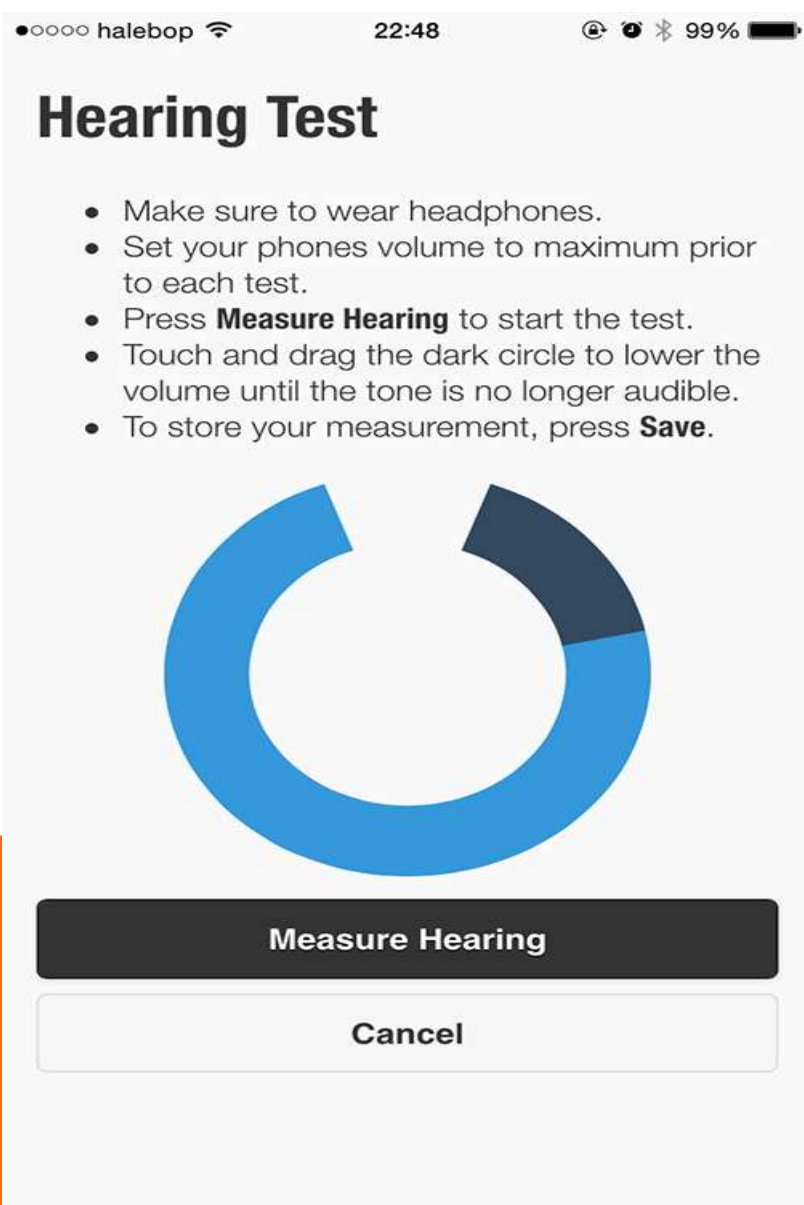
TTS = Temporary Threshold Shift

- Glutamate ototoxicity or structures of the cochlea becoming detached
- Resolves in 16-18 hours

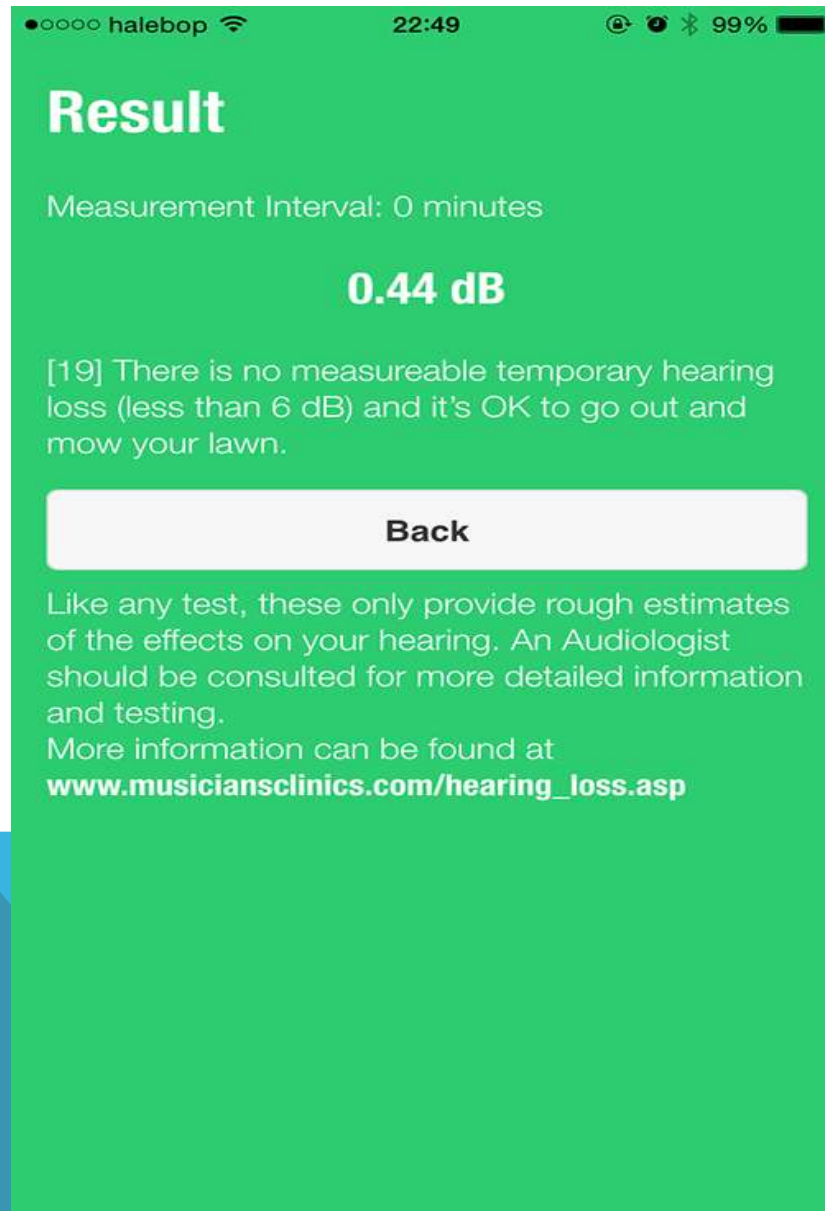
PTS = Permanent Threshold Shift

- Usually caused by either necrosis or apoptosis.

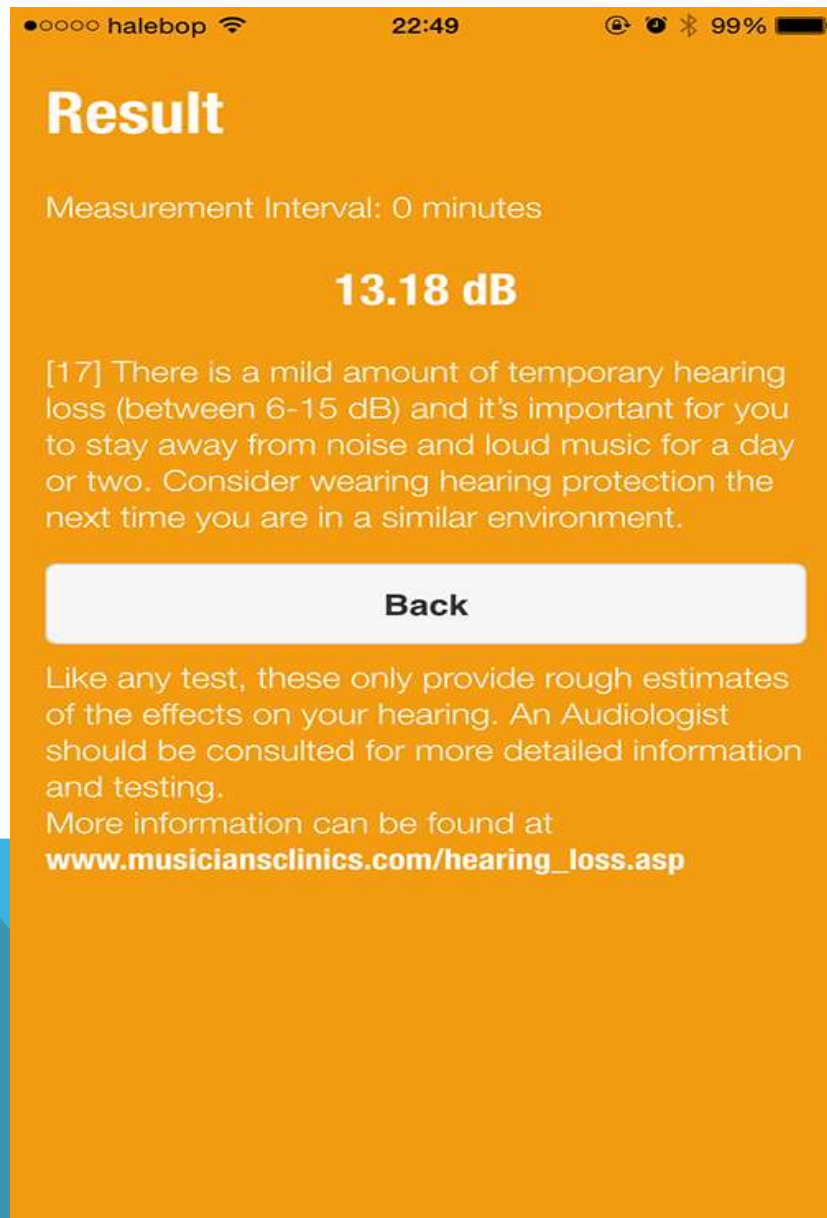
TEMPORARY HEARING LOSS TEST APP



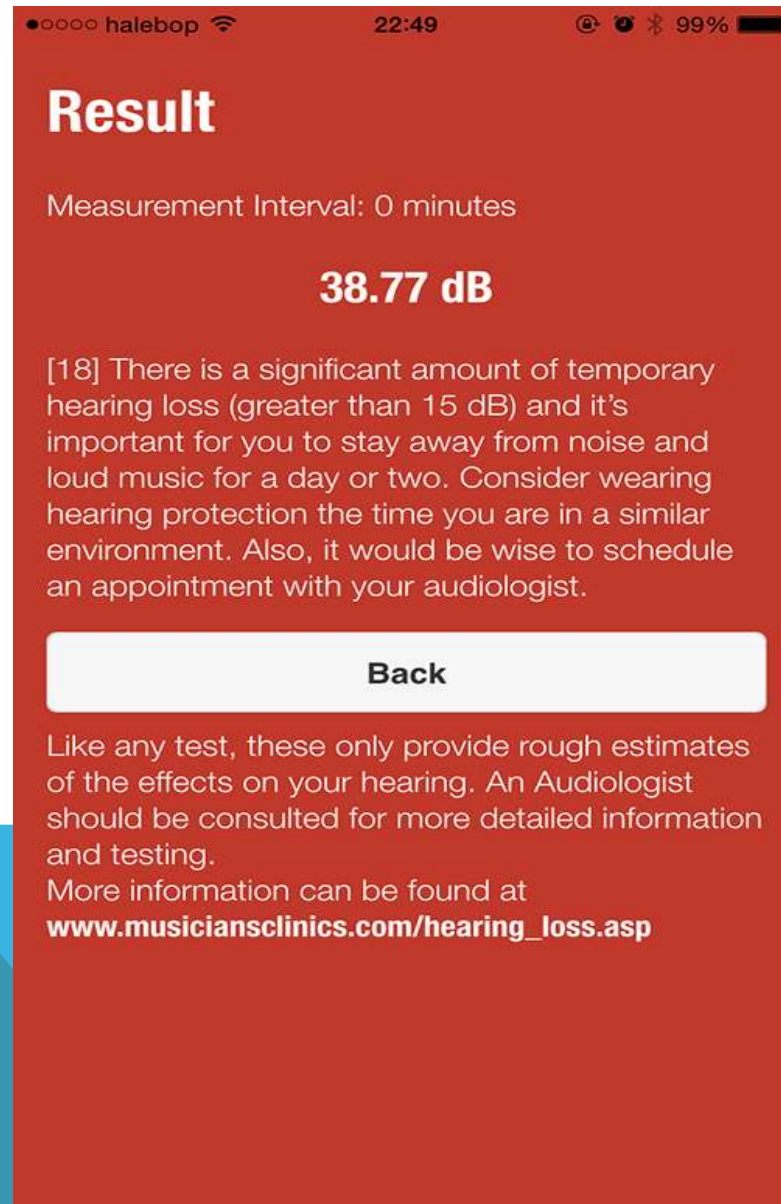
TEMPORARY HEARING LOSS TEST APP



TEMPORARY HEARING LOSS TEST APP



TEMPORARY HEARING LOSS TEST APP



SO FAR... THE BIG THREE ...

Moderation

Hearing protection

Improved monitoring



...AND THE FOURTH IS...

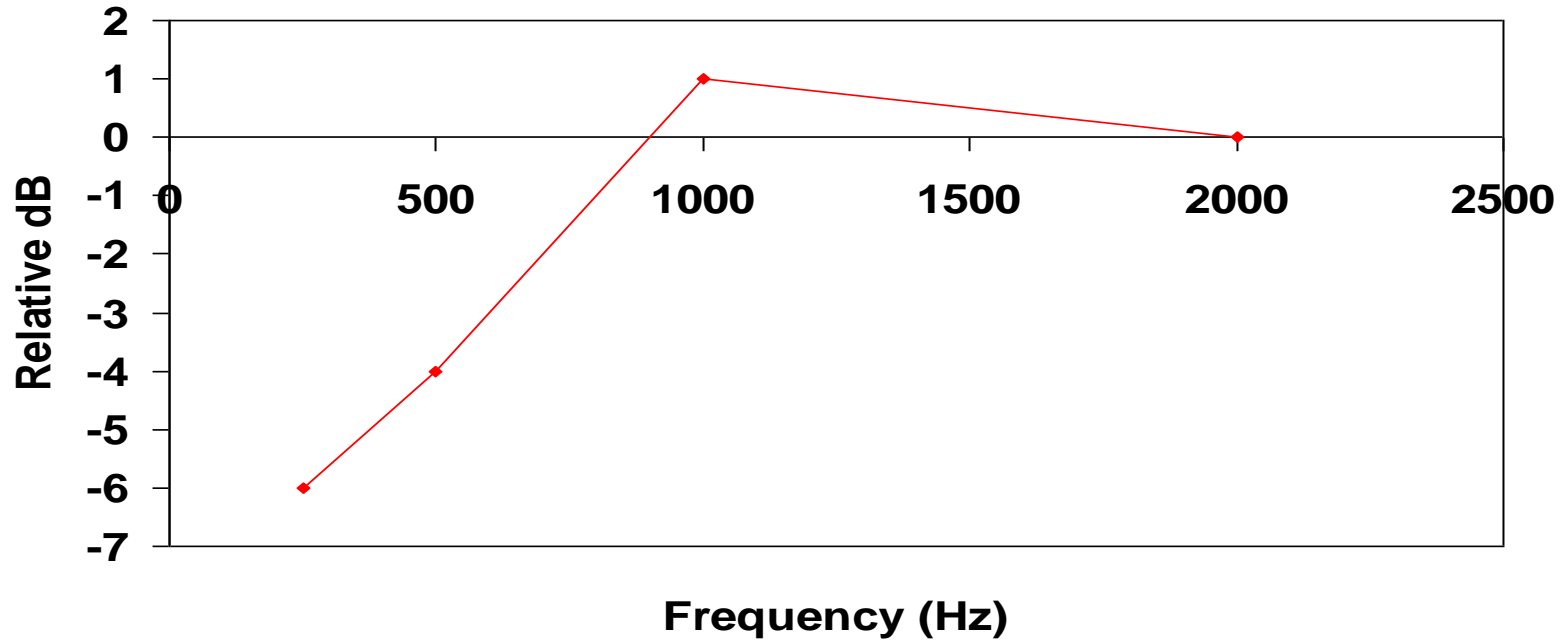
***FOUR ENVIRONMENTAL
TECHNIQUES TO REDUCE
NOISE/MUSIC
EXPOSURE***



***1. SPEAKER/AMPLIFIER
COMBINATIONS SHOULD BE
ELEVATED FROM THE FLOOR.***



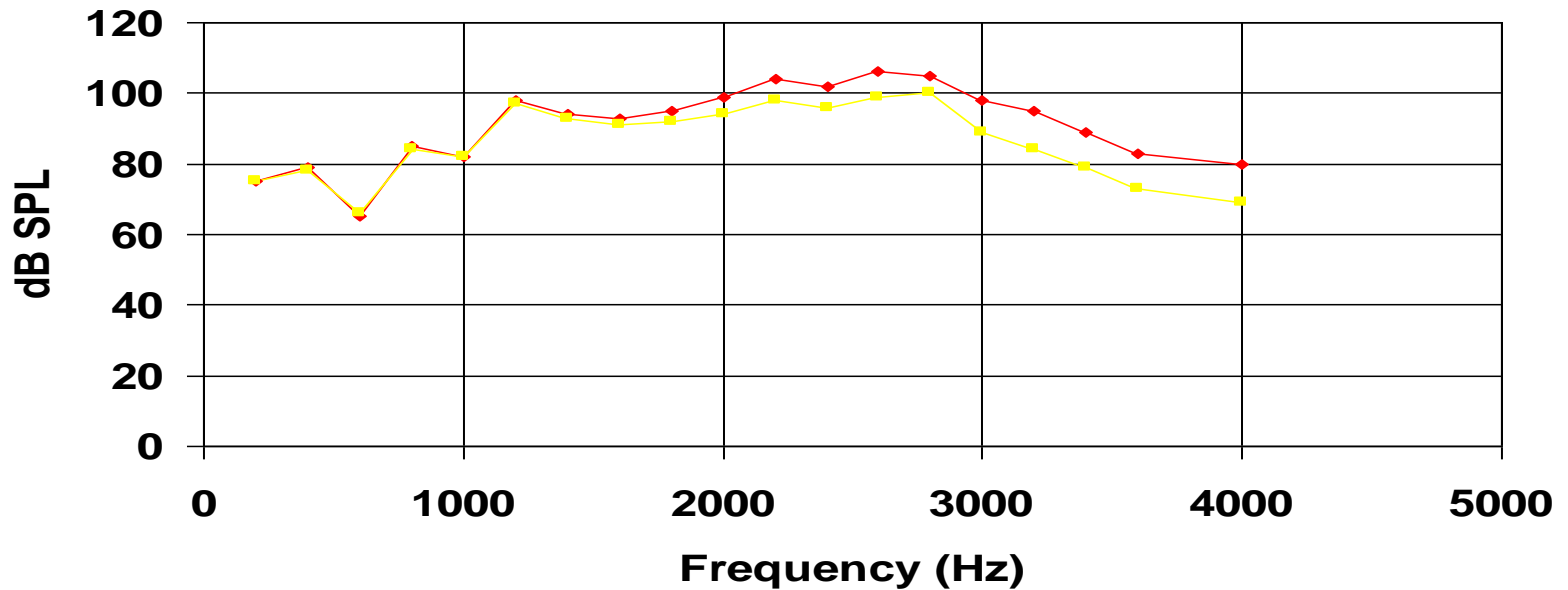
ENERGY LOSS WITH LOUDSPEAKER IN CONTACT WITH FLOOR



**2. STRINGS SHOULD ALWAYS HAVE AT
LEAST TWO METERS OF
UNOBSTRUCTED SPACE ABOVE
THEM.**



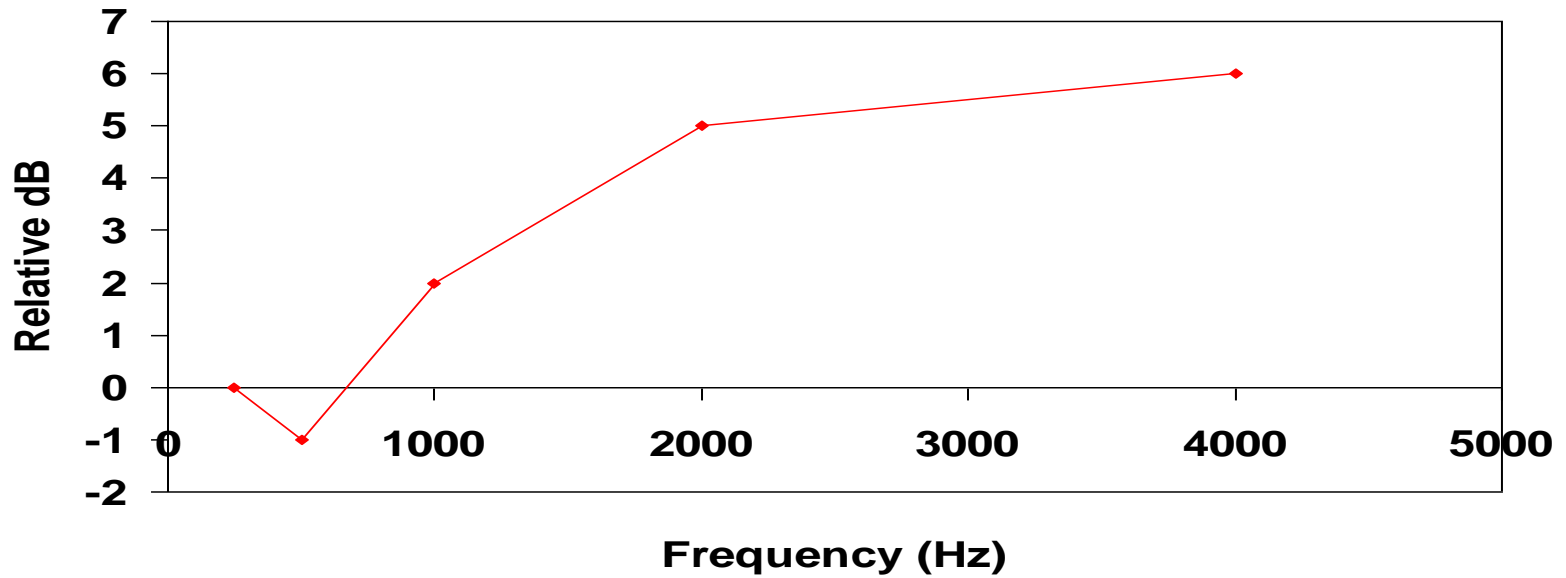
HIGH FREQUENCY LOSS WITH A POORLY CONSTRUCTED PIT OVERHANG



**3. *TWO METERS OF UNOBSTRUCTED
FLOOR SPACE IN FRONT OF THE
ORCHESTRA.***



TWO METERS OF UNOBSTRUCTED FLOOR SPACE IN FRONT OF ORCHESTRA



***4. TREBLE BRASS INSTRUMENTS
SHOULD BE ON RISERS.***



MARSHALL.CHASIN@ROGERS.COM

WWW.MUSICIANSCLINICS.COM

WWW.HEARINGHEALTHMATTERS.ORG

