

*OSHA's Approach to Noise
Exposure in Construction*

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Objectives

- Provide technical information on construction noise and hearing conservation
- Explain current expectations
- Review 8/5/2002 OSHA Hearing Conservation for Construction Workers Advance Notice of Proposed Rulemaking
- Sell you on this program so you can sell to management and employees

Presentation Outline

- Construction Noise Levels
- Noise-Induced Hearing Loss
- Prevention
 - Noise Measurements
 - Hearing Protectors
 - Audiometric Testing
 - Noise Control
- Current and Future OSHA Standards
- Benefits of Hearing Conservation Programs

Construction Noise Levels

Current OSHA Standards

- 1926.52 Occupational Noise Exposure
 - TABLE D-2 - PERMISSIBLE NOISE EXPOSURES

Duration per day, hours	Sound Level dBA slow response
8.....	90
6.....	92
4.....	95
3.....	97
2.....	100
1 1/2.....	102
1.....	105
1/2.....	110
1/4 or less.....	115

Sound Pressure Level

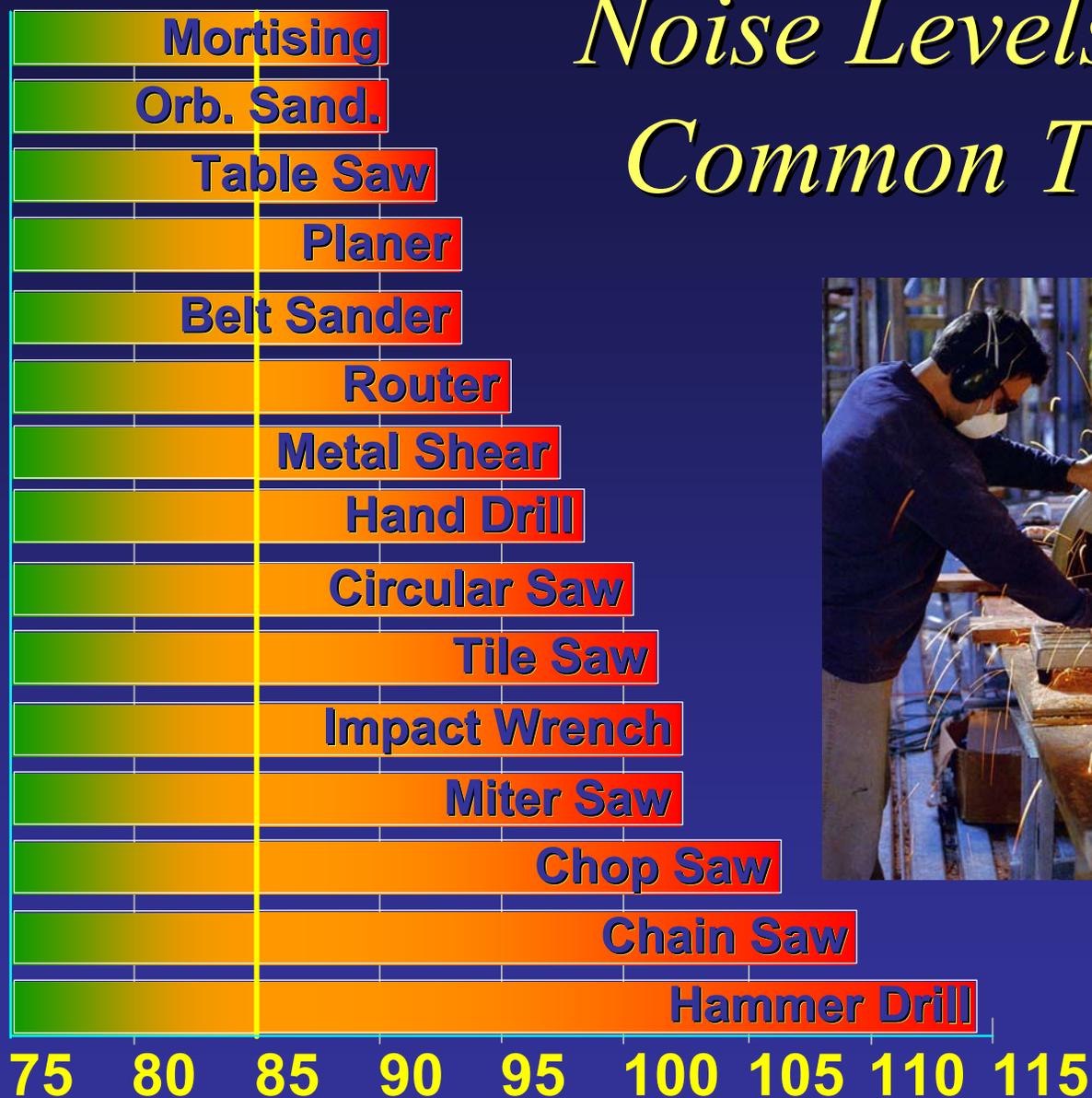
- Pressure wave traveling in air or water
- Expressed in decibels (dB)
 - It is the perceived loudness
- Analogy: surface wave made when you throw a stone into a calm pool of water

Sound Pressure Level

- Logarithmic scale
- Small dB increase represents large increase in sound energy.
- 3 dB increase is a doubling of sound energy
- 10 dB increase represents a 10-fold increase
- 20 dB increase represents a 100-fold increase

Noise Levels for Common Tools

Task/Tool



Source: NIOSH

Construction Noise Levels

Pneumatic chip hammer	103-113	Crane	90-96
Jackhammer	102-111	Hammer	87-95
Concrete joint cutter	99-102	Gradeall	87-94
Skilsaw	88-102	Front-end loader	86-94
Stud welder	101	Backhoe	84-93
Bulldozer	93-96	Garbage disposal (at 3 ft.)	80
Earth Tamper	90-96	Vacuum cleaner	70

Source: Center To Protect Worker's Rights

DECIBEL - dB(A)**EQUIPMENT**

**Double protection
recommended
above 105 dB(A)**

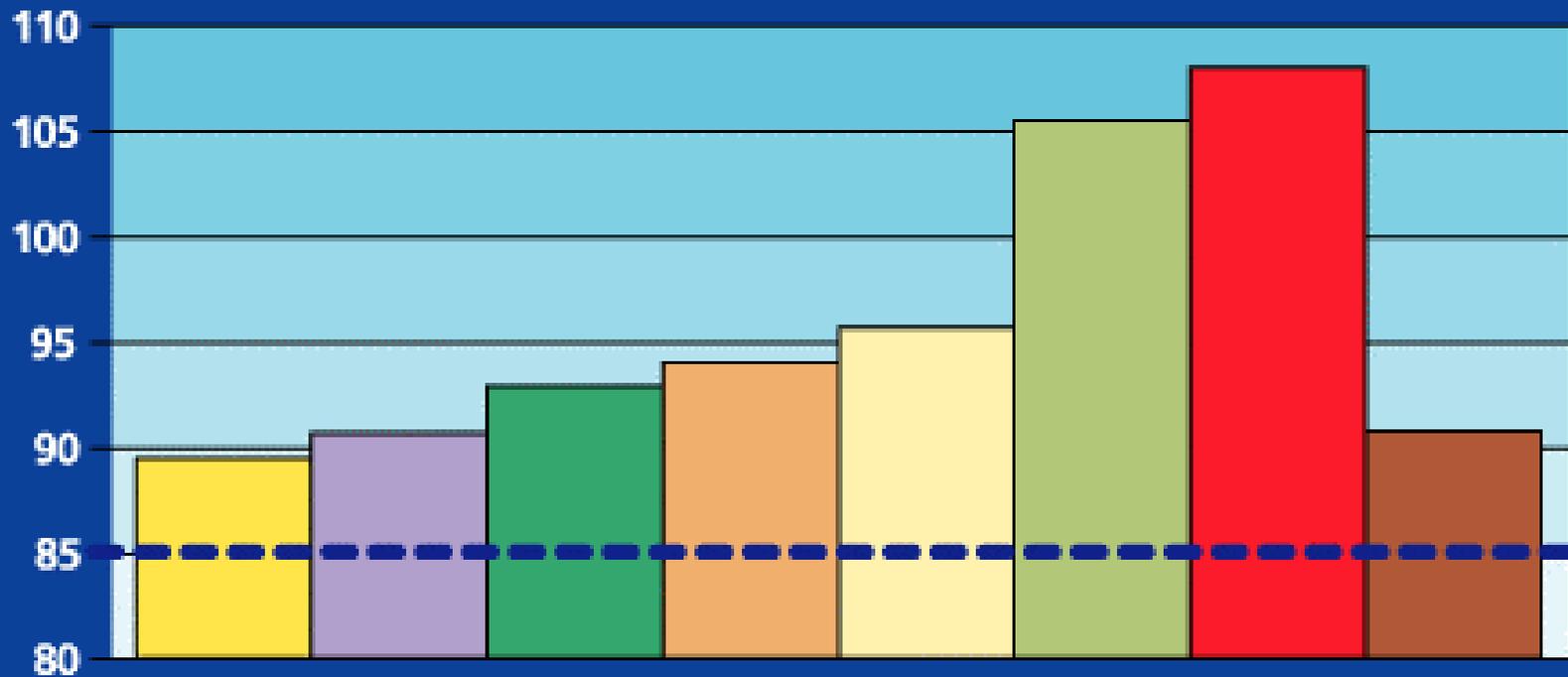
112	Pile driver
110	Air arcing gouging
108	Impact wrench
107	Bulldozer - no muffle
102-104	Air grinder
102	Crane - uninsulated cab
101-103	Bulldozer - no cab
97	Chipping concrete
96	Circular saw and hammering
96	Jack hammer
96	Quick-cut saw
95	Masonry saw
94	Compactor - no cab
90	Crane - insulated cab
87	Loader/backhoe - insulated cab
86	Grinder
85-90	Welding machine
85	Bulldozer - insulated cab
60-70	Speaking voice

**Hearing protection
recommended
above 85 dB(A)**

Table 1: Some typical noise levels found on construction sites

Source: Construction Safety Association of Ontario

Graph 1: Average dB(A) For Some Construction Trades / Activities



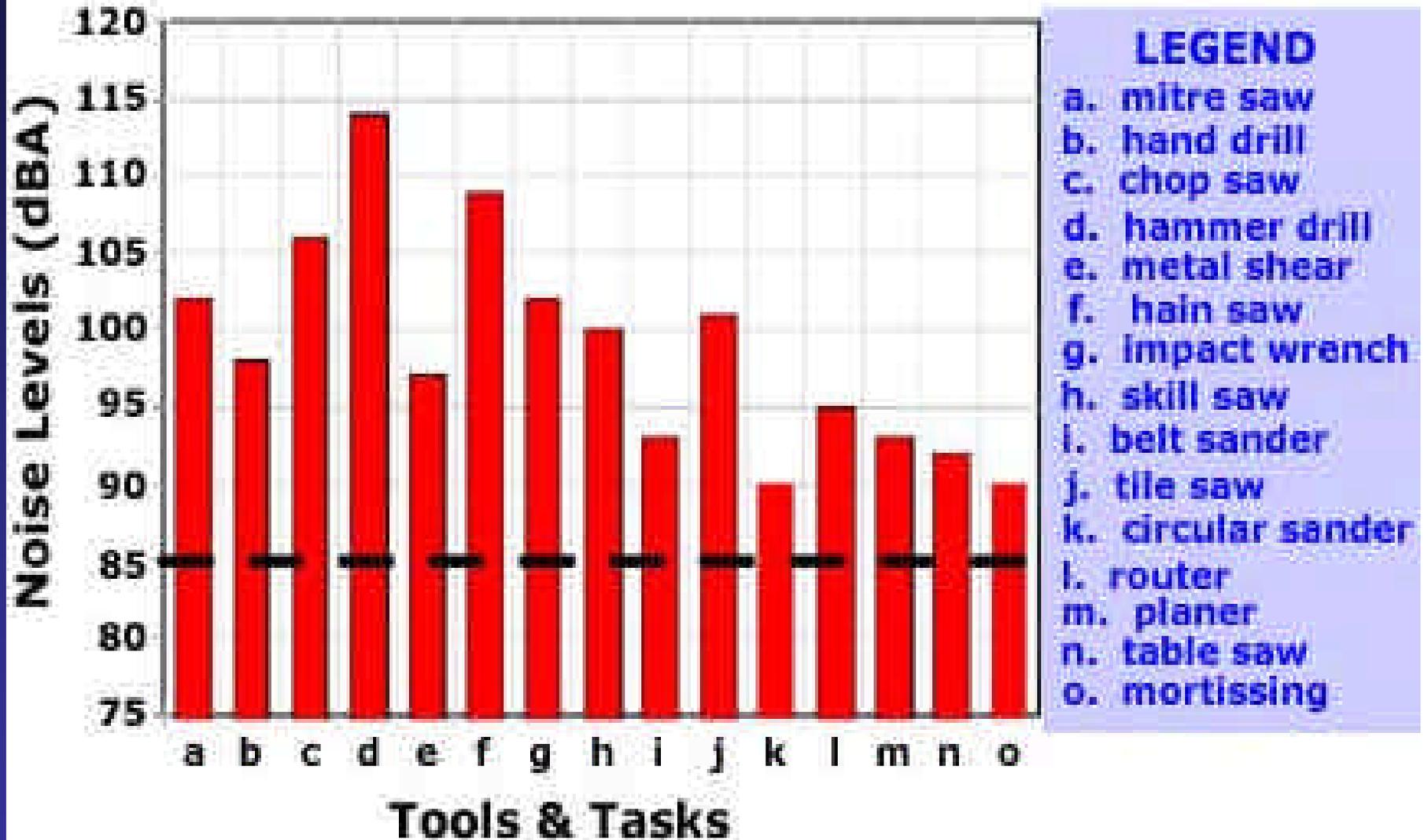
Source: Construction Safety Association of Ontario

Average Daily Noise Exposure Levels (8-hour TWA) of Heavy Equipment and Associated Laborers

(adapted from Legris and Poulin, 1998)

Operator and Task	Range in dBA
Heavy-duty bulldozer	97-107
Vibrating road roller	91-104
Light-duty bulldozer	93-101
Asphalt road roller	85-103
Laborers	78-107
Crawler crane < 35 ton (non-insulated cab)	93-101
Crawler crane >35 ton (non-insulated cab)	90-98
Crawler crane >35 ton (insulated cab)	80-89
Rubber-tired crane >35 ton (non-insulated cab)	78-90
Rubber-tired crane >35 ton (insulated cab)	59-87
Tower Crane	70-76

CARPENTERS' NOISE EXPOSURES



Source: NIOSH

Presumed Noise Levels

British Columbia Standard

- Presumes specific construction occupations are routinely overexposed to noise
 - Carpenters
 - Plumber pipefitters
 - Sprinkler installers
 - Mobile equipment oprs
 - Welders/fabricators
 - Concrete workers (pumps, vibrators, jackhammers)
 - Drywallers shooting tracks or boarding
 - Sandblasters
 - Drillers
 - Electricians
 - Steel erectors

OSHA Inspection Data



- Chipping Concrete Floor
96 dBA (TWA) at 4.5 hours

Source: OSHA Madison case file

OSHA Inspection Data

- Abrasive Blasting
with Sponge-Jet
Material
105 dBA (TWA)
at 6 hours



(3.5 X PEL for silica)

Source: OSHA Madison case file

OSHA Inspection Data

- Vermeer Saw Operator
95 dBA (7 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- Jackhammering - 102 dBA (7.5 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- Bobcat Operator Breaking Pavement
112 dBA (7 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- Lateral Drilling - 97 dBA (6.5 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- Lateral Drilling - 104 dBA (7 hour sample)



Source: OSHA Chicago North case file

OSHA Inspection Data

- Partner Saw - 98 dBA (7 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- 36" Wall Saw - 100 dBA (4.5 hour sample)



Source: OSHA Aurora case file

OSHA Inspection Data

- Tuckpoint Grinding - 99 dBA (2.5 hour sample)



Source: OSHA Chicago North case file

OSHA Inspection Data

- Sandblasting – 125 dBA (4 hour sample)
Inside hood – 109 dBA



Source: OSHA Aurora case file

High Noise Exposures

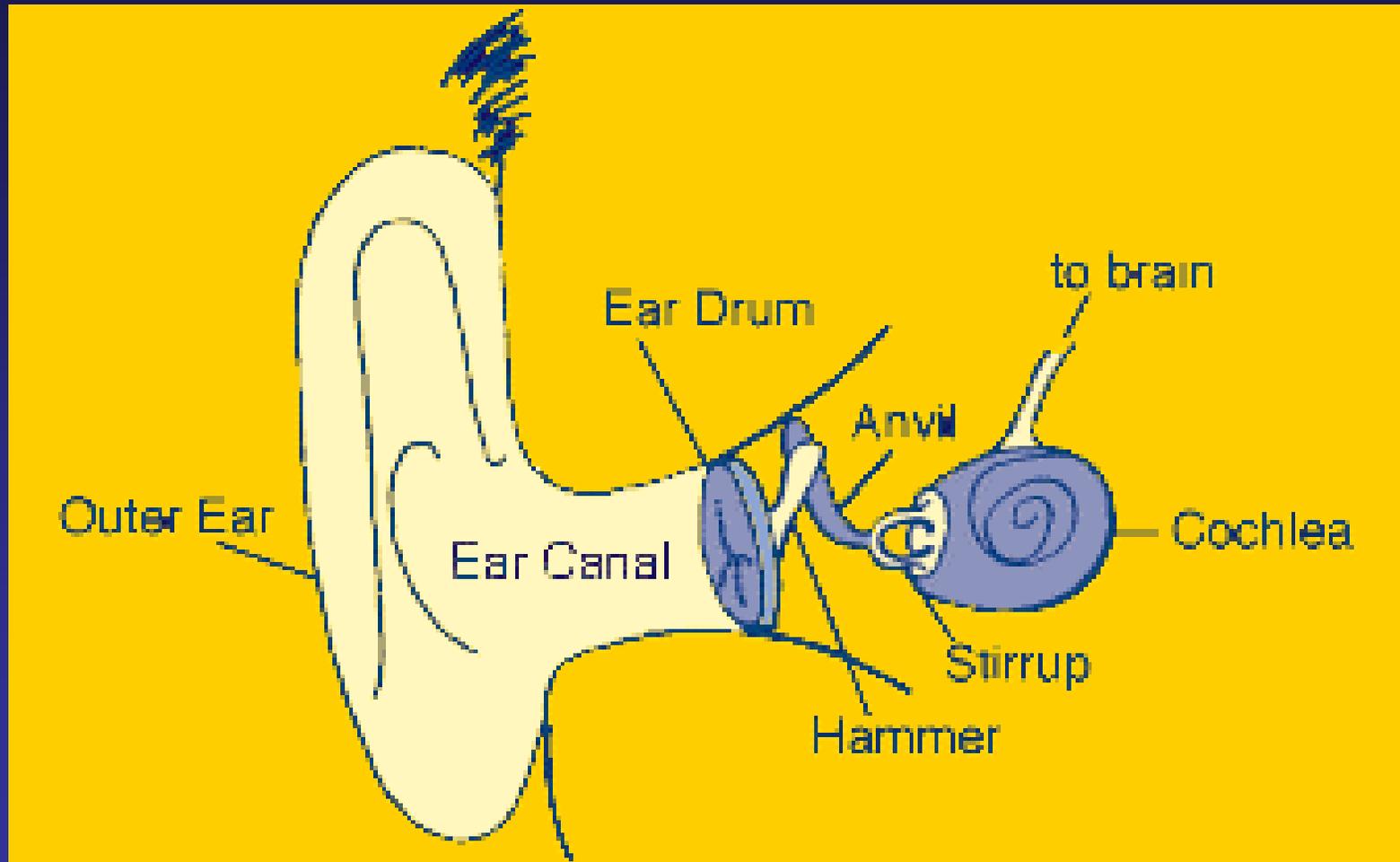
Rules of Thumb

- Above 90 dBA when you have to raise your voice to be heard standing next to a person
- Need protection:
 - When using electric, gasoline, or air powered tools
 - When sitting in an open cab of dozers, rollers, some cranes, earth moving or road building equipment

Noise-Induced Hearing Loss

NIHL

Brief Overview – How Ears Work



- A-weighted response simulates the sensitivity of the human ear at moderated levels.

How Does Excessive Noise Damage Your Ears?

- Microscopic hair cells of the cochlea are exposed to intense noise over time
- Hair cells become fatigued and less responsive, losing their ability to recover.
- Damage becomes permanent resulting in noise-induced permanent threshold shift.

Risk of Hearing Loss

- Estimated Risk of Incurring Material Hearing Impairment as a Function of Average Daily Noise Exposure Over a 40-year Working Lifetime
(*source: NIOSH*)

• Average Exposure	90 dBA	29%
• Average Exposure	85 dBA	15%
• Average Exposure	80 dBA	3%

Audiometric Testing

What Is The Purpose of Having a Hearing Test on a Regular Basis?

- An audiometric testing program is used to track your ability to hear over time.
 - Baseline and annual
- Test records provide the only data that can be used to determine whether the program is preventing noise-induced permanent threshold shifts. It is an integral part of the hearing conservation program.

Case Study 1. Teenage Girl

From the American Academy of Family Physicians website, Rabinowitz article

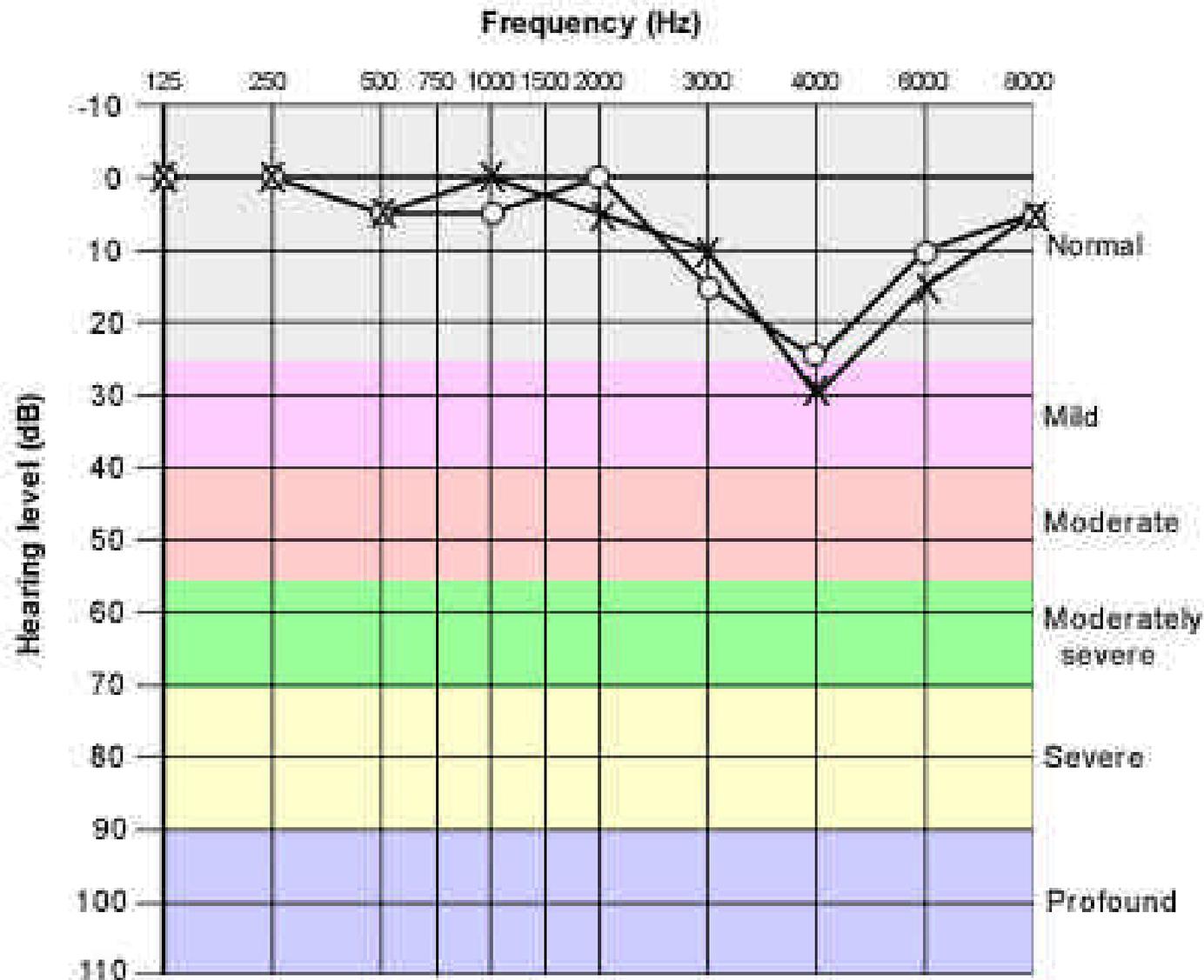


FIGURE 1.
Audiogram
findings in the
patient in case 1.

The area below
the curves
represents
sound levels that
the patient could
still hear.
(X = left ear;
O = right ear)

Case Study 1 Conclusion

- “**Temporary threshold shift**“ example
- Common in persons exposed to high noise
- Represents transient hair cell dysfunction
- Complete recovery can occur
- Repeated episodes of such shifts causes permanent threshold shifts because hair cells in the cochlea are progressively lost.

Case Study 2 *Factory Worker Age 55*

From the American Academy of Family Physicians website, Rabinowitz article

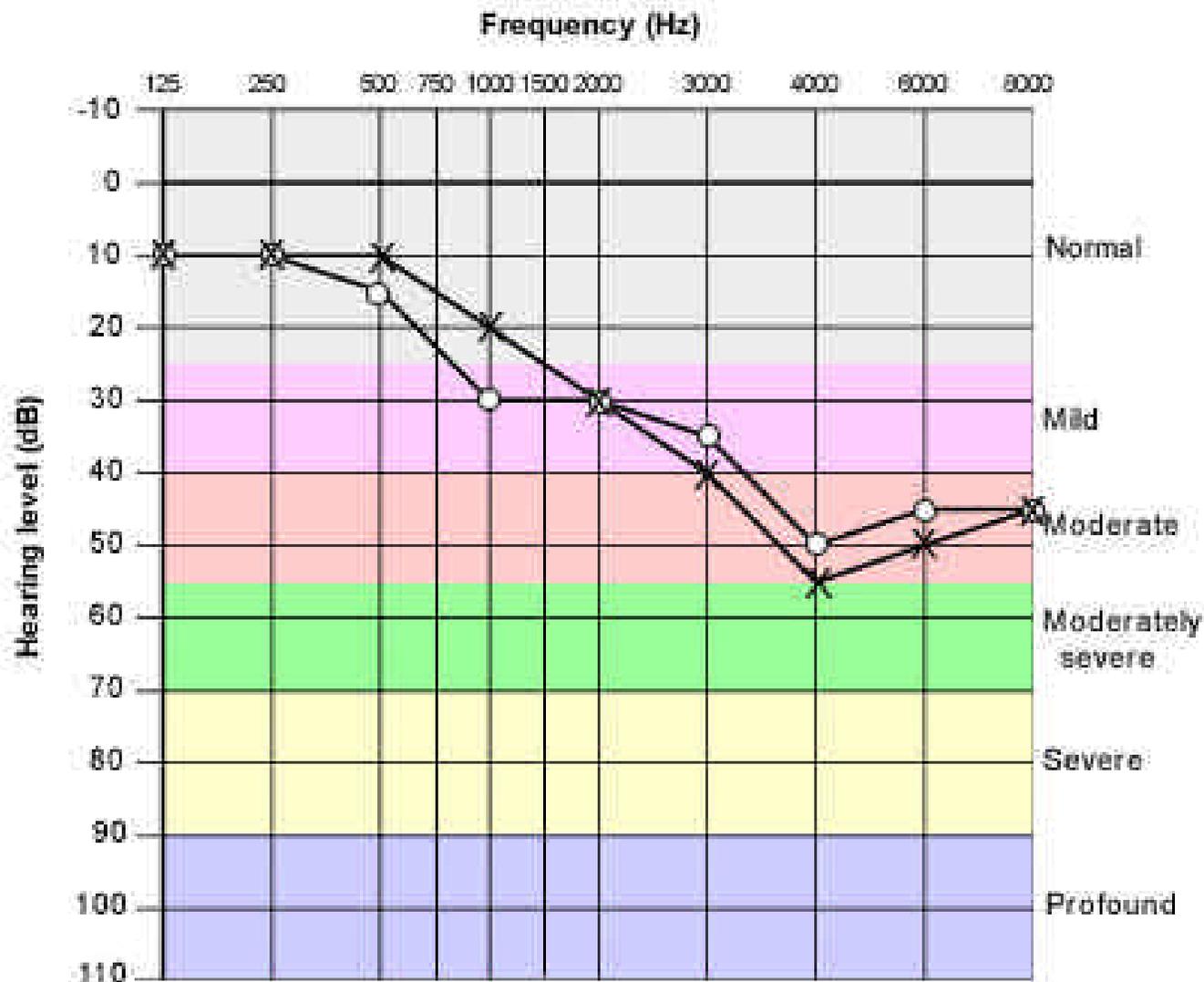


FIGURE 2.
Audiogram findings
in the patient in
case 2.

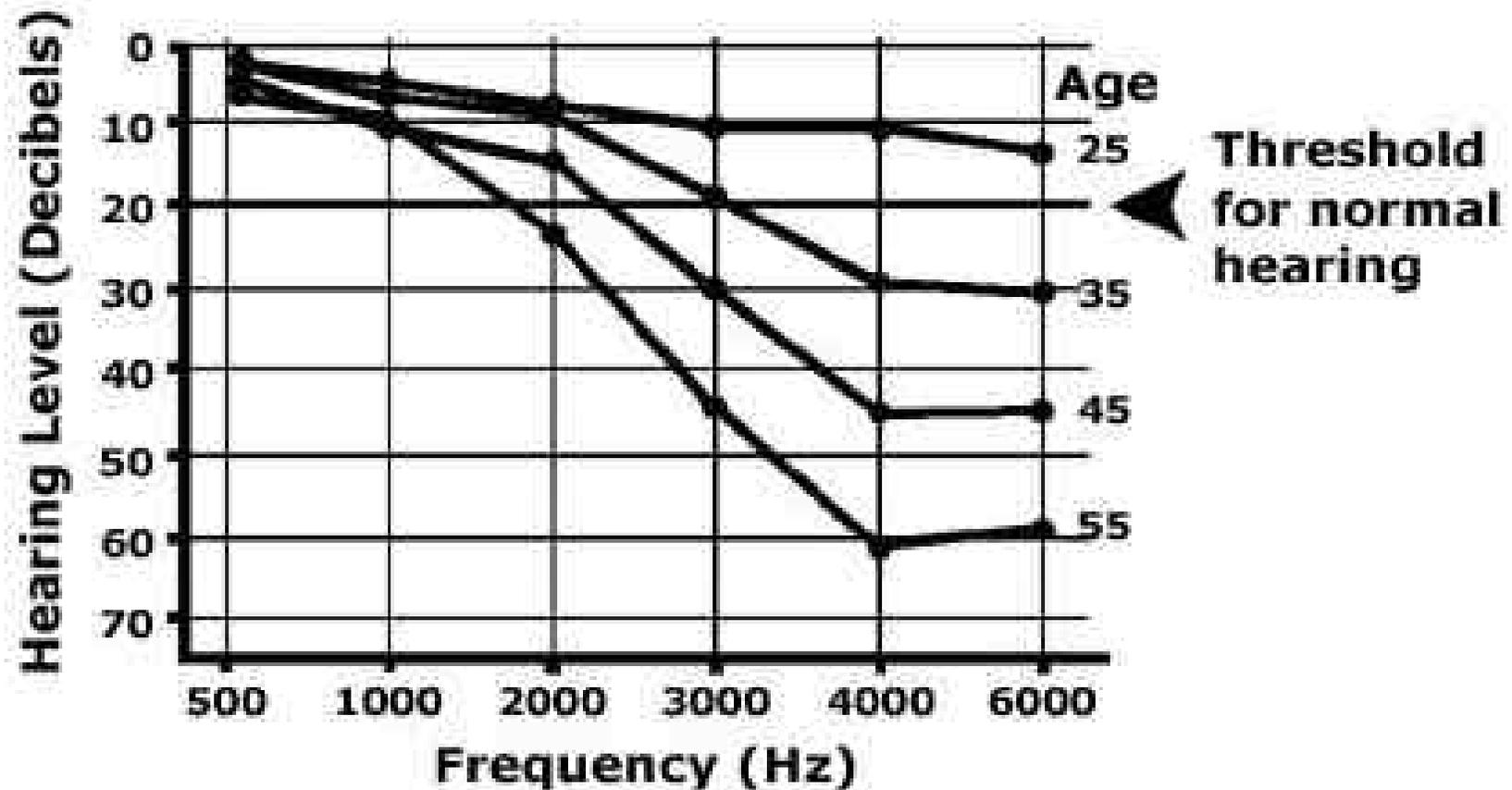
The area below the
curves represents
sound levels that
the patient could
still hear. (X = left
ear; O = right ear)

Case Study 2 Conclusion

- Noise Induced Hearing Loss
 - Speech discrimination and social function interference
 - Difficulty in perceiving and differentiating consonant sounds
 - Words "run together"
 - Sounds such as a baby crying or a distant telephone ringing, may not be heard at all.
- Tinnitus
 - Common symptom of noise overexposure
 - Further interferes with hearing acuity, sleep and concentration.
- These impairments have been associated with social isolation, depression and an increased risk of accidents.

Carpenter Hearing Losses by Age

Age of Carpenter & Hearing Loss



Source: NIOSH

Audiometric Test Services

- Mobile Testing Services
- Fixed Site (Occ Health Clinics, Hospitals)
 - Make sure they have a booth or partitioned area, not a noisy room!
- How To Find

Noise Measurements

Noise Measurements

- Sound level meters
 - A device that measures the intensity at a given moment
 - Spot check



Noise Measurements

- Noise dosimeters
 - A dosimeter is like a sound level meter except that it stores sound level measurements and integrates the measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday.



Hearing Protection

Hearing Protection

- Ear Plugs
- Ear Muffs
- Dual protection
- Active noise cancellation
- Amplification devices
- NRR calculations

What Hearing Protective Devices Will Work Best?

Type	Advantages	Disadvantages
Formable Ear Plugs (foam)	<ul style="list-style-type: none">-Cooler, more comfortable under hot conditions-Can readily dispose of after each use-Lightweight	<ul style="list-style-type: none">-Irritation to outer ear (for some people)-Sometimes fit problems
Reusable Ear Plugs (plastic)	<ul style="list-style-type: none">-Cooler, more comfortable under hot conditions-Can be reused if cleaned properly-Lightweight	<ul style="list-style-type: none">-Irritation to outer ear (for some people)-Sometimes fit problems
Ear Muffs	<ul style="list-style-type: none">-Easy to use no fit problems	<ul style="list-style-type: none">-Not as effective if anything (even glasses) breaks the seal-Heavier/Warmer than plugs

Noise Reduction Rating

- A hearing protector's ability to reduce noise is its Noise Reduction Rating (NRR).
- The greater the NRR, the better the noise attenuation.
- The NRR is usually listed on the hearing protector box.



Noise Reduction Rating Calculation

– For A-weighted readings don't simply subtract NRR from exposure level 1910.95 Appendix B

– (dBA - (NRR-7 dB))

- Example (plugs or muffs):

TWA = 109 dBA, NRR= 29

$109 - (29-7) = 109 \text{ dBA} - 22\text{dB} = 87 \text{ dBA}$

- Suggest you shoot for 80 dBA as a protection factor for poor fit/use



NIOSH NRR Calculation

<http://www.cdc.gov/niosh/98-126f.html>

- Earmuffs - Subtract 25% from the mfr's NRR
- Formable earplugs - Subtract 50% from the mfr's NRR
- All other earplugs - Subtract 70% from the mfr's NRR

- Formula

$$\text{Noise level} = \text{dBA} - (\text{derated NRR} - 7)$$

Dual Protection

- Using plugs and muffs simultaneously
- Actual attenuation depends on many factors
- Reduction is not near what you would expect

- NRR calculation:
 - Take the higher NRR and add 5 to the field adjusted NRR

Active Protection

- May help but not recognized by OSHA in NRR calculations
- Active headphones use destructive interference to cancel low-frequency noise while still allowing the wearer to hear mid- and high-frequency sounds such as conversation and warning sirens.
- Used extensively by pilots, active headphones are considered indispensable in helicopters and noisy propeller-driven aircraft.

Hearing Protection: Problems

- Undue reliance on protection without steps to reduce noise exposure at source
- Poor choice of protector
- Incorrect fitting
- Inadequate maintenance
- Inconsistent use negates most of the protective effect

Noise Control

Noise Controls for Construction Equipment (Schneider et al., 1995)

Equipment	Noise Controls
Pile Driver	Enclosure, muffler
Stone saw cutting	Noise control pad with water
Handheld impact drills	Reduction of reflected sound
Circular saw blades	15° tooth angle, new tooth configuration, slotted saw blades, viscoelastic damping
Pneumatic tools	Muffler
Pavement breaker/ Rock drill	Muffler, enclosure of cylinder case and front head, moil damping
Portable air compressor	Muffler, acoustic enclosures

Noise Controls for Construction Equipment (Schneider et al., 1995) **(continued)**

Equipment	Noise Controls
Bulldozer	Cab-liner material, enclosure, sound absorption in canopy, sealing of all openings
Wheeled loader	Absorption of sound cooling air route
Vibratory roller	Flexible mounting for pump compartment
Joint Cutter	Anti-vibration mounting fixtures

Noise Control

- Replace worn, loose, or unbalanced machine parts that cause vibration.
- Keep machine parts well lubricated to reduce friction.
- Acoustical enclosures and barriers around generators
- Sound absorbing material and vibration isolation systems on hand tools
- Quiet work practices - use rubber mallets to erect and dismantle formwork.

*Current/Proposed OSHA
Hearing Conservation Standards*

Current Expectations

- 1926.52(d)(1) Implement hearing conservation programs for employees exposed to 90 dBA average and above
- Audiograms
 - Season long employees
 - Long term year after year employees
 - One year mobile testing van exception per 1910.95(g)(5)(ii)
 - Don't forget exposed shop employees
- Training
- 1926.101 Hearing Protection

Proposed Standard

- Apply general industry standard to construction, 85 dBA average and above
 - Monitoring
 - Audiograms
 - Hearing Protection
 - Training
 - Recordkeeping
- Modifications proposed by the public under the rulemaking process

*Benefits of a Hearing
Conservation Program*

Worker's Compensation Claim Statistics in Wisconsin - 2000

Loss of Hearing

- 725 claims
- Lost wage compensation
\$4, 855, 750

Hernia

- 1,267 claims
- Lost wage compensation
\$2,292, 408

Worker's Compensation Claim Statistics in Wisconsin - 2001

Loss of Hearing

- 696 claims
- Lost wage
compensation
\$5,727,122

Hernia

- 1,179 claims
- Lost wage
compensation
\$2,270,330

Hearing Loss Affects Safety Program

- Workers with NIHL may not hear audible warnings and safety signals.
- Hearing impairment jeopardizes not only affected employees but others who work with them.
- NIHL may interfere with daily life, especially during social activities in noisy settings.
- High incidence of fatalities from being struck by objects, transportation incidents, and frequency of fatal accidents from moving machines—especially pedestrians.
- *Break down in communication*

Hearing Loss Affects Safety Program

- Increased effort to listen may lead to fatigue, anxiety, and stress.
- Those affected may feel increasingly isolated from family and friends.
- Some people with NIHL also suffer from *tinnitus*, causing them to hear ringing, buzzing, rushing, whistling, or hissing when there are in fact no sounds to be heard.

Contractor Comments

Hearing Conservation Programs

- “Audiogram cost was minimal”
- “Cost is the easy part.”
- “Was not hard to do except the time to do dosimetry”
- “Insurance companies will often do monitoring”
- “Program was easily accomplished using a safety consultant”

Contractor Comments

(continued)

- “Transient workforce is an issue”
- “Not a big problem to get employees to use hearing protectors. Machine operators are good about it, others maybe not so good.”
- “Have got to sell the program and get buy-in”

Contractor Comments

(continued)

- Some of the unions could step up to the plate and offer audiograms as a service to contractors.”
- “It would be good to have an audiogram card for workers to carry from job to job. Having a guy get 4-5 audiograms a year will make him mad and discredit the program.”

What You Can Do Now

- Monitoring
- Equipment noise labels
- Purchase equipment with noise in mind
- Sell employees on hearing protector use
- Audiometric testing program

Contact Information

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<http://www.osha.gov/SLTC/constructionnoise/index.html>

Extensive use of NIOSH, The Center To Protect Workers Rights, and the Construction Safety Association of Ontario materials was made. We thank those organizations for the use of their information in the advancement of hearing conservation.