MIOSHA Training Institute

MIOSHA Michigan Occupational Safety and Health Administration

Macomb Community College

Part 380. Occupational Noise Exposure

Student Materials
MTI Level Two Compliance Course
Consultation Education and Training Division
Michigan Occupational Safety and Health Administration
Michigan Department of Labor and Economic Opportunity
www.michigan.gov/miosha
517-284-7720

MICHIGAN DEPARTMENT OF LABOR & ECONOMIC OPPORTUNITY

(Revised 03/24)

MIOSHA Michigan Occupational Safety and Health Administration

Part 380. Occupational Noise Exposure (29 CFR 1910.95)

Presented By:
Consultation Education and Training Division
Michigan Occupational Safety and Health Administration
Michigan Department of Labor and Economic Opportunity
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517-284-7720

MIOSHA
Michigan Occupational Safety and Health Administration

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Objectives

- Explain the requirements of MIOSHA's Part 380. Occupational Noise Exposure Standard (1910.95).
- Conduct "hands-on" noise monitoring using noise dosimeters with actual noise sources (In seat offerings only).
- Describe what a Standard Threshold Shift (STS) is and when it must be recorded on MIOSHA Injury and Illness Logs.
- Determine how to select and use appropriate hearing protection.

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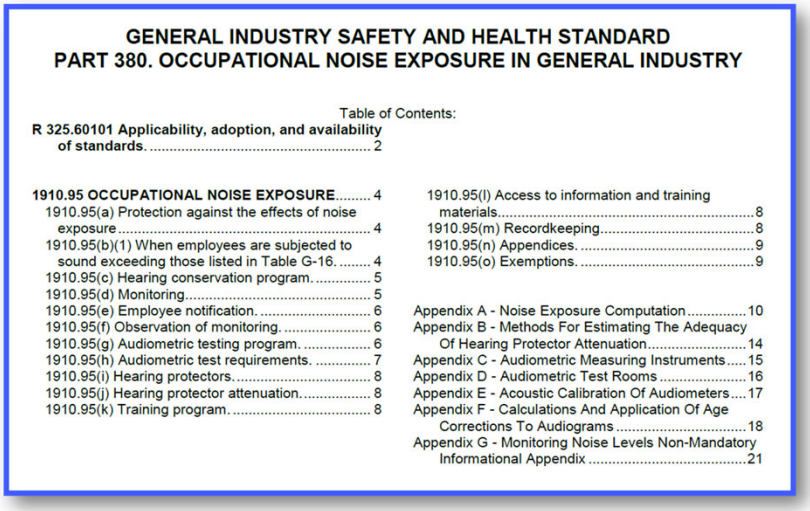
Part 380



GENERAL INDUSTRY SAFETY AND HEALTH STANDARD
PART 380. OCCUPATIONAL NOISE EXPOSURE IN GENERAL INDUSTRY

Table of Contents:

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Sound versus Noise

- Sound
  - A pressure variation most commonly occurring in air which is made up of tones or wave frequencies expressed in units of Hertz (Hz).
  - Audible sound range is between 20 Hz and 20,000 Hz.
  - The intensity of sound (i.e., loudness) is measured in units called decibels (dB).
- When sound is unwanted, excessively loud or unpleasant, we refer to it as noise.

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Why Decibels?

Loudness is measured using a **Logarithmic Scale**.

This means that a ten-decibel increase does not simply add ten to the previous level. It multiplies the previous level by ten.

Average threshold of Hearing.....	0 dBA
Quiet Room.....	45 dBA
Normal Conversation.....	55 dBA = 45 dBA x 10
Car (50 mph at 50 ft).....	65 dBA = 45 dBA x 100
Leaf Blower (at 50 ft)	75 dBA = 45 dBA x 1,000
Motorcycle (at 30 ft).....	85 dBA = 45 dBA x 10,000
Leaf Blower (at 3 ft).....	95 dBA = 45 dBA x 100,000
Power Mower (at 3 ft).....	105 dBA = 45 dBA x 1,000,000
Chainsaw (at 3 ft).....	115 dBA = 45 dBA x 10,000,000

115 dBA has **ten million times** more sound energy than 45 dBA.

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Permissible Noise Exposure Limit (PNEL)

- The time-weighted average (TWA) PNEL over an eight-hour workday is **90 dBA**.
- MIOSHA/OSHA uses a 5 dB exchange rate, meaning when the noise increases 5 dB….the employees allowed exposure *(time)* is cut in half.

TABLE G-16
PERMISSIBLE NOISE EXPOSURES[1]

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

Footnote[1] When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect shall be considered, rather than the individual effect of each. If the sum of C(1)/T(1) + C(2)/T(2) C(n)/T(n) exceeds unity, then the mixed exposure shall be considered to exceed the limit value. C(n) indicates the total time of exposure at a specified noise level, and T(n) indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

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Allowable Daily Noise Exposure if No Hearing Protection is Worn

Noise Source	Allowed Unprotected Exposure Duration	Sound Level
• Electric ventilation fans	8 hours	90 dBA
• Drill press	6 hours	92 dBA
• Shop vac	4 hours	95 dBA
• Drum sander	3 hours	97 dBA
• Emergency siren	2 hours	100 dBA
• Wood planer	1.5 hours	102 dBA
• Circular saw	1.0 hours	105 dBA
• Chain saw	0.5 hours	110 dBA
• Jackhammer	0.25 hours	115 dBA
• Power-driven nail gun	**NONE**	120 dBA

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Noise Screening

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Anatomy and Physiology of the Ear

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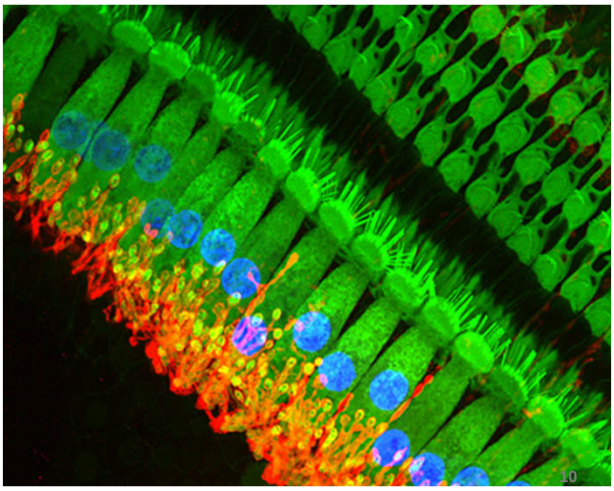
Effects of Excessive Noise

- Loss of hearing *(temporary and/or permanent)*
- Increases heart rate and blood pressure
- Constriction of blood vessels leading to tension and stress
- Nervousness, sleepiness and fatigue



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Causes of Hearing Loss

- **Non-occupational:**
- Presbycusis
  (i.e., loss due to aging)
- Disease and birth defects
- Medications and injury
- Auditory canal obstructions
  (e.g., wax)
- Hobbies

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Causes of Hearing Loss

- **Occupational:**
  - Injury (sudden traumatic event)
  - Illness (prolonged exposure to excessive noise levels)
  - Chemical exposures (ototoxic chemicals or medications)
    (e.g. toluene, styrene, lead, mercury)
  - Tinnitus:
    - Ringing or whistling in ears, often early sign of overexposure and/or auditory nerve defect

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Ototoxins

Substance Class	Chemicals
Pharmaceuticals ***Ototoxicity at therapeutic doses is limited***	Aminoglycosidic antibiotics (e.g. streptomycin, gentamycin) and some other antibiotics (e.g. tetracyclines), Loop diuretics* (e.g. furosemide, ethacrynic acid) Certain analgesics* and antipyretics* (salicylates, quinine, chloroquine) Certain antineoplastic agents (e.g. cisplatin, carboplatin, bleomycin).
Solvents	Carbon disulfide, n-hexane, toluene, p-xylene, ethylbenzene, n-propylbenzene, styrene and methylstyrene, trichloroethylene.
Asphyxiants	Carbon monoxide, hydrogen cyanide and its salts, tobacco smoke
Nitriles	3-Butenenitrile, cis-2-pentenenitrile, acrylonitrile, cis-crotononitrile, 3,3'-iminodipropionitrile.
Metals and Compounds	Mercury compounds, germanium dioxide, organic tin compounds, lead.

OSHA/National Institute for Occupational Safety and Health (NIOSH) ***Preventing Hearing Loss Caused by Chemical (Ototoxicity) and Noise Exposure*** (Publication No. 2018-124)
https://www.cdc.gov/niosh/docs/2018-124/pdfs/2018-124.pdf

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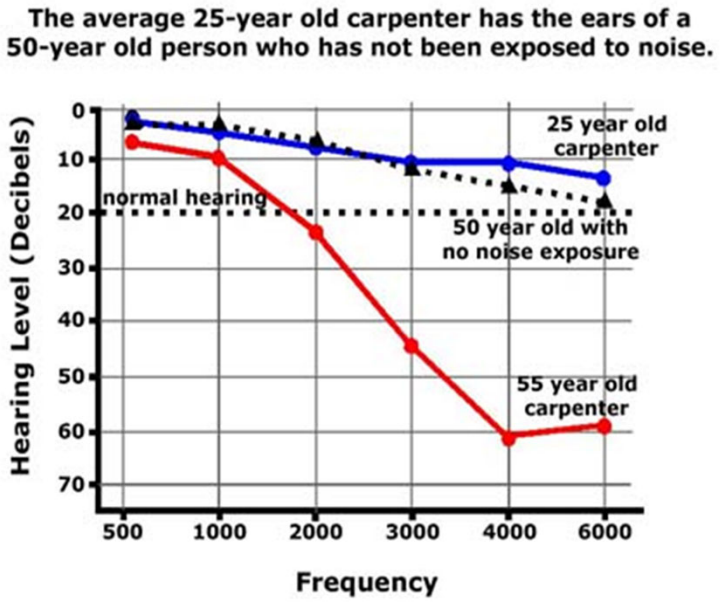
Normal vs Abnormal Hearing Loss



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Evaluation of Hearing Loss

- Temporary threshold shift:
  - Decrease in hearing sensitivity which usually returns to former levels within minutes to hours post exposure
- Permanent threshold shift:
  - **Irreversible** sensorineural hearing loss from repeated exposure

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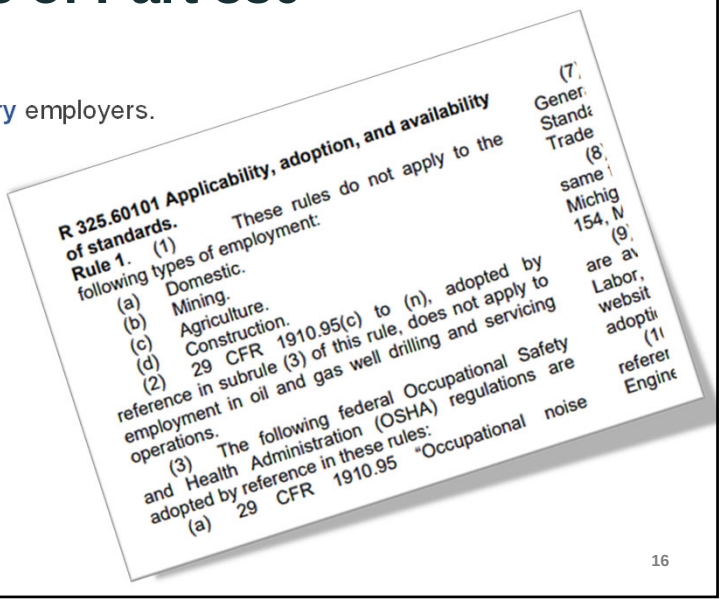
Basic Requirements of Part 380

This Standard **applies to General Industry** employers.

It does **NOT** apply to following types of employment:

- Domestic
- Mining
- Agriculture
- and Construction



R 325.60101 Applicability, adoption, and availability of standards.

Rule 1. (1) These rules do not apply to the following types of employment:

(a) Domestic.

(b) Mining.

(c) Agriculture.

(d) Construction.

(2) 29 CFR 1910.95(c) to (n), adopted by reference in subrule (3) of this rule, does not apply to employment in oil and gas well drilling and servicing operations.

(3) The following federal Occupational Safety and Health Administration (OSHA) regulations are adopted by reference in these rules:

(a) 29 CFR 1910.95 "Occupational noise

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Basic Requirements of Part 380 (cont.)

- Hearing conservation program
- Noise monitoring program
- Engineering and/or administrative controls
- Hearing protection
- Audiometric testing program
- Employee training
- Recordkeeping
- Posting a copy of Part 380

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Exceeding the Permissible Noise Exposure Limit – Noise Controls Required

If exposure exceeds 90 dBA (eight-hour TWA)

- **Must** implement feasible engineering or administrative controls
- Hearing protection **required** if not reduced < 90 dBA

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Noise Exposure Levels

>90 dBA	➔Permissible Noise Exposure Limit (PNEL): eight-hour TWA (90 dBA)
≥ 85 dBA and ≤ 90dBA	➔Action Level (AL): eight-hour TWA (85 dBA)
< 85 dBA	➔Eight-Hour TWA below 85 dBA: Acceptable

Note: 2 dB margin of error is used for enforcement purposes.
All exposures are averaged over an eight-hour time period.

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Impact or Impulse Noise

- **Maximum permissible level is 140 dB.**
- These are single peaks which have separation intervals greater than one second between each peak.
- Difficult to measure accurately.
- Protection: May need double hearing protection, isolation booth, or to implement noise controls to reduce peak level below 140 dB.
- Examples of possible sources:
  - Single bullet being fired
  - Iron mallets striking metal plates to repair dents
  - Air bag testing

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A-Weighted Scale Measurements

- Compliance with the Permissible Noise Exposure Limit (PEL) and the action level (AL), both eight-hour TWAs, are determined by an instrument that is set on slow response using the A-weighted scale.
- Results are indicated in dBA.
- A-weighted scale measures frequencies most similar to human hearing.

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Requirements of a Hearing Conservation Program (HCP)

- Must be implemented when employee noise exposures equal or exceed the action level (i.e., > 85 dBA)
- **Elements of a Hearing Conservation Program include**:
  - Noise monitoring
  - Audiometric testing (baseline and annual)
  - Standard Threshold Shift (STS) determination and follow up procedures
  - Hearing protection
  - Employee training and information (post the Standard)
  - Recordkeeping

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Noise Monitoring Program

Employee exposure equals or exceeds action level ➔ implement noise monitoring program:

- Identify employees to include in HCP
- Use representative personal monitoring
- Calibrate equipment
- Repeat monitoring if change in workplace

Employee observation and notification of monitoring results

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Noise Monitoring – Techniques and Equipment

- **Area survey**
  - Walking around with a sound level meter or dosimeter to estimate area noise at appropriate locations to identify the people that need to have personal monitoring
- **Personal monitoring**
  - Determining an individual employee's eight-hour TWA
- **Sound level meter**
  - Can be used for area survey – instant SPL measurements
  - Cannot be used for personal monitoring
- **Personal noise dosimeter**
  - This can be used for area surveys or personal monitoring

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Summary of Requirements

***NOTE**: Per OSHA, feasible administrative or engineering controls shall be utilized when the PNEL is exceeded.*

8-hour TWA

Required hearing conservation program:

- Noise monitoring
- Employee training
- Audiometric tests
- Provide hearing protection
- Recordkeeping
- Posting

< 85 dBA ← **No mandatory requirements**

≥ 85 dBA and ≤ 90dBA → **Required** hearing conservation program and use of controls:

- Engineering
- Administrative
- PPE

> 90 dBA

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Noise Exposure Determination – Determining TWAs

Time Weighted Average (TWA) means that sound level which, if constant over an eight-hour exposure, would result in the same noise exposure as is measured.

Example:

- 85 dBA for four hours and
- 85 dBA for another four hours
- Results in 85 dBA TWA for eight hours not 170 dBA

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Case Study – Prosperity Inc.

- Personal noise monitoring results (eight-hour TWA):
  - Warehouse = 75 dBA
  - Buffing and Grinding Area = 95 dBA
  - Assembly Area = 87 dBA
- Indicate applicable general requirements of the Standard for each area

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Hearing Protection

Requirements and How to Use

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Hearing Protectors

- Provide a variety of suitable protectors to all exposed at or above the action level (i.e., at least two types)
- Must be worn when:
  - Exposed at or above Permissible Noise Exposure Limit (PNEL)
  - Between Action Level (AL) and PNEL and experienced an STS
  - Mobile test van provides audiogram later than six months after first exposure >AL
- Selection of protectors
- Training in use of protectors
- Fitting of hearing protectors

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Types of Hearing Protection (HP)

Traditional Passive HP

- No electronic components
- Disposable and reusable plugs – soft or firm
  - Most common, variety of types and least expensive
- Earmuffs
  - More expensive, more comfortable for some, lasts longer
- Custom made ear plugs
  - Personal, permanent, and more expensive

Note: HP used must attenuate to **at least** 90 dBA (< 85 dBA if an STS)

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Types of HP (cont.)

- ***Level Dependent*** hearing protection
  - Degree of hearing protection provided changes based on level of noise
  - Ideal for intermittent noise (military, hunting)
  - **Electronic**: battery powered and uses environmental microphones
  - **Passive**: uses pressure sensitive filters, good for impulse noise
  - Utilizes conventional HP as well
  - Can be in the ear or over the ear

Hearing Protection Selection

- Rather than seek “maximum” NRR, match the device to the requirements
  - Consider noise level
  - Consider spectrum
  - Consider use
  - Consider comfort

Fitting Foam Ear Plugs

Roll the earplug up into a small, thin "snake" or “golf tee” with your fingers.
You can use one or both hands.

Pull the top of your ear up and back with your opposite hand to straighten out your ear canal.
The rolled-up earplug should slide right in.

We used to say, “hold the earplug in with your finger”. Now, roll it down and insert it as far as you can. Your voice will sound muffled when the plug has made a good seal.

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Proper Fit of Foam HP

Good fit or poor fit?

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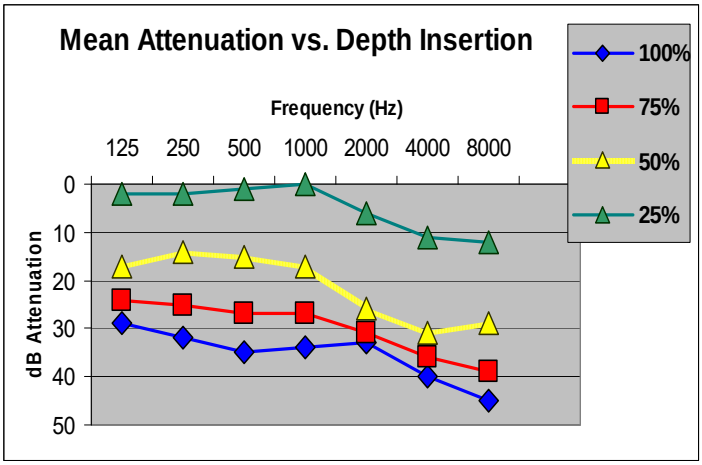
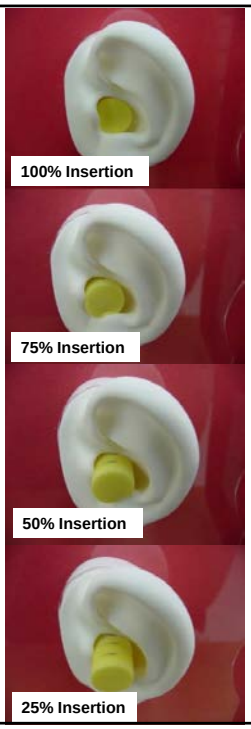
Effect of foam earplug insertion depth on attenuation



Credit: John Hall, Wright Patterson AFB OH



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HP Fit Verification (aka Fit Testing)

- Uses a computer-based system to verify fitting
- Uses persons own ear plugs
- Establishes a Personal Attenuation Rating (PAR)
- Maintains a record of the results

Michigan Department of Labor & Economic Opportunity

Note: MIOSHA does not endorse any product.

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Hearing Protection "Fit Testing"

- Not "required" by MIOSHA
- Measures hearing with and without hearing protection in place
- Provides *estimate* of *actual* attenuation provided by protector for that individual…*at that point in time.*
- Can provide a great "training opportunity"

SENSITIVITY WITH HPD WORN	-	SENSITIVITY WITHOUT HPD WORN	=	DIFFERENCE (Noise Reduction)

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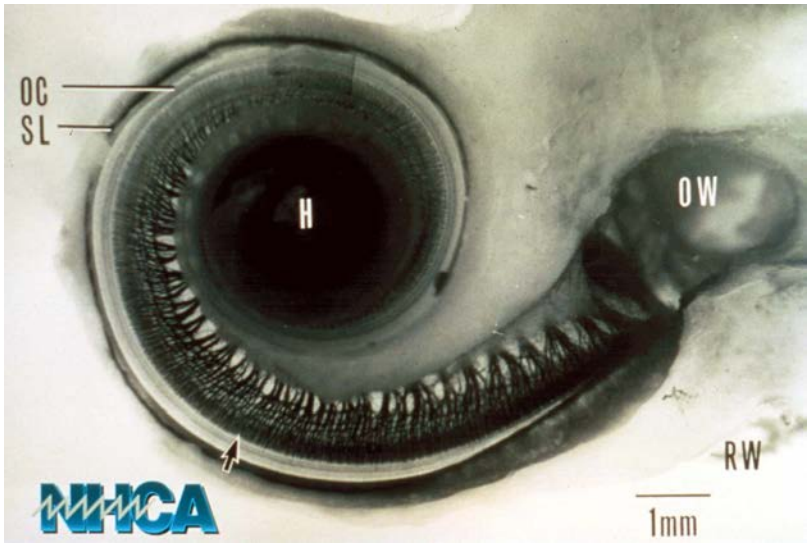
Why is wearing hearing protection important?
Cochlea of a 45-year-old male who has worked in a 90dB noise for 20 years and **has consistently** worn ear protection.



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Cochlea of a 45-year-old male who has worked in a 90dB noise for 20 years, **without** wearing ear protection.

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NIOSH Sound Level Meter App

The NIOSH Sound Level Meter app can measure workplace noise to determine if workers may experience hazardous noise exposure. The free app combines the best features of professional sound levels meters and noise dosimeters into one simple tool. The app was created to empower people to test noise levels in their workplace, make informed decisions about noise exposure, and prevent occupational hearing loss.

Key Features

- Developed by experienced acoustics engineers and hearing loss experts.
- Tested and validated.
- Free to download.
- Provides an accurate measurement of noise levels using any iOS device.
- Provides informational screens on hazardous noise levels, conducting noise measurements, selecting a hearing protector, and hearing loss guidelines.
- Provides the most relevant metrics found in professional sound instruments today.
- Connects to technical support from NIOSH hearing experts.

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Personal Noise Dosimeters

How to Use

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Personal Noise Dosimeters

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Using a Dosimeter

- Placement on shoulder
  - Outside edge of shoulder
  - Closest to noise
- Microphone needs a wind screen
- Dosimeter versus Sound Level Meter (SLM)
  - Dosimeter - provides actual TWA personal noise exposure
  - Dosimeter - can do area sampling as well as personal
  - Dosimeter - more expensive and complicated to use
  - SLM – provides a good area survey
  - SLM – inexpensive and easy to use
  - SLM – no data logging capability

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Lab Exercise

- At this time, students will practice using noise dosimeters.

NOTE:
Demonstration noise clips on the next few slides

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Conveyor Noise – Video Clip

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Washer Noise – Video Clip

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Dosimeter Printout – Defining Terms

- **Criterion Level**
  - The constant sound level in dB that, if applied for eight-hours, would accumulate a DOSE of 100%
- **Dosimeter 1**
  - Based on an 80 dB threshold and 90 dB criterion, slow response time and 5 dB exchange rate
  - Used for **Action Level (AL)** exposure determination
- **Dosimeter 2**
  - Based on a 90 dB threshold and 90 dB criterion, slow response time and 5 dB exchange rate
  - Used for **Permissible Noise Exposure Limit (PNEL)** determination
- **Peak Level**
  - The highest instantaneous sound pressure, in decibels, that occurred during the measured time-period

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Dosimeter Printout – Defining Terms

- **LAVG**
  - The average sound level, in decibels (or dBA), for the time period actually measured.
- **TWA** (Time-weighted Average)
  - The sound level in decibels that is accumulated for a measured time period, but whose average is computed over an eight-hour time period.
    - Measured on the A-weighting scale, slow response, with a 5 dB exchange rate (MIOSHA).
    - If measured time period < eight-hours, TWA always < LAVG
    - If measured time period > eight-hours, TWA always > LAVG
    - If measured time period = eight-hours, LAVG = TWA

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Dosimeter Printout – Defining Terms

- **Dose**
  - Percentage of allowable sound energy that a person may be exposed to during a workday based on the criterion level, threshold level, and exchange rate selected for the particular dosimeter.
    - **Criterion Level** (CL) – The constant sound level in dB that, if applied for eight-hours, would accumulate a DOSE of 100%.
    - **Exchange Rate** (ER) – The number of decibels that a sound must change to either halve or double the rate of dose accumulation (e.g., 3, 4, 5, or 6 dB exchange rates are common).
    - **Threshold Level** (TL) – A preset level in decibels below which sound is not accumulated or averaged into LAVG, LEQ, or Dose.

- **PDose** (Projected Dose)
  - A percentage computed by measuring dose for some time period and extrapolating the measurement to a different time period (e.g., extrapolating the dose to an eight-hour time period).

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Noise Control Technology

Case Studies and Assessment

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Agenda - Noise Controls

Explain:

- Case study examples (overview)
- Steps associated with tackling noise issues
- Instrumentation
- Ways to address noise issues
- Costs associated with Hearing Conservation Programs

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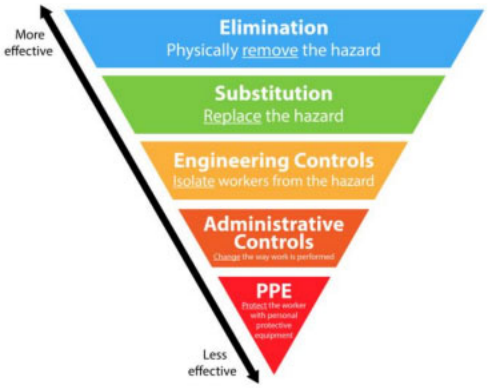
Noise Control Technology

1. Engineering controls
2. Administrative controls
3. Personal protective equipment (PPE)

OSHA Technical Manual Chapter on Noise is a great free reference!

https://www.osha.gov/dts/osta/otm/new_noise/index.html

See Section V. Hazard Abatement and Control, sub-section A. Engineering Controls



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Best Practice - Engineering Controls

- Stamping/Pressing machines - Acoustical enclosure, isolation mounts
- Vibratory feeders - Noise dampening coating
- Noisy fans - Proper maintenance, balance
- Vibrating/Noisy pipes- Pipe wrap
- Air compressors - Acoustical enclosure
- Heat exchanger- Enclosure with baffling
- Reflective rooms - Acoustical panels
- Chains and toothed belts

For further case study related information:

www.hse.gov.uk/noise

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Controls Process

1. Investigate the source, detect the dominant noise amplitude and frequency
2. Address how the dominant noise source is being produced and the different options to handle it
3. Determine the best methods of noise control to meet the goals of the facility
4. Implement the solution

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Instrumentation

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

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Sound Level Meter

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

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Spectrum Analyzer

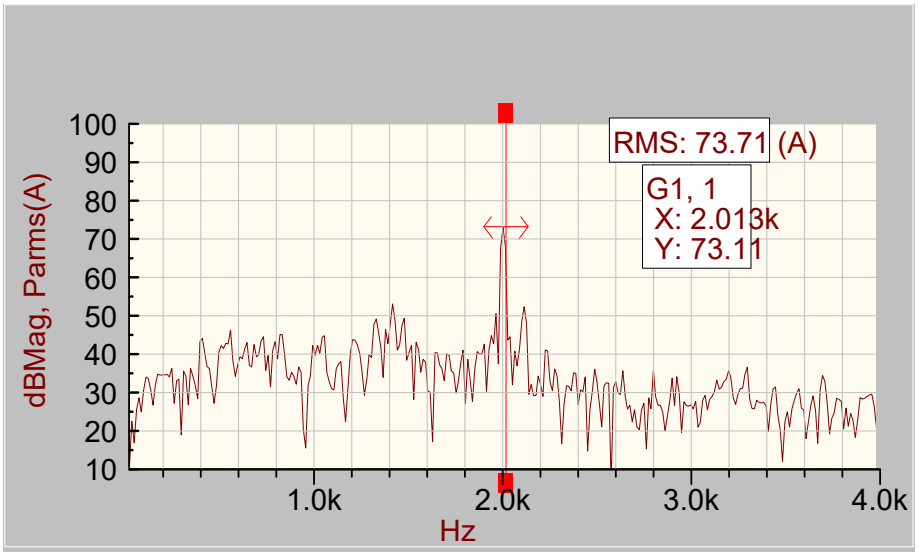

Photo courtesy of Memtech Acoustical

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Don’t acquire data when …

- There are unstable test conditions (sporadic background noise, impacts, etc.)
- High wind is present
- Insufficient sample time is available
- Surrounding people (or you) are talking
- Adjoining machines are louder than the machine under test
- Machine under test is not operating at proper speeds/feeds

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The Basics of Addressing Noise Issues

- If you can't identify the frequency content, location(s), and potential noise mechanisms of a source, then your chances of solving the problem are greatly reduced
- Determine what noise level reduction is needed, and work systematically to achieve that level
- Trial and error is expensive, time consuming, and often unsuccessful; this has given "noise abatement" a bad reputation

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Option 1. Prevent noise at the source

- If the root cause of the noise can be identified, consider solutions to eliminate the problem
- This is often the **least expensive** yet still highly effective
- For example…
  - Assure that **proper maintenance** is being performed
  - Replace worn bearings or parts
  - Looseness or misalignment
  - Balance rotating equipment
  - Improper application of equipment

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Old, worn equipment

Photo courtesy of Memtech Acoustical

Option 2. Mitigate the noise

- Dampen/control the noise that is being produced at or near the source
- Objective is to reduce the energy flow from the source to the environment
- Damping and/or isolating are good examples of mitigating the noise

Dampening Compound (Spread on ducts, metal partitions, or joints)

Note: MIOSHA does not endorse any product.

Vibratory Bowl Treatment

Chains and Toothed Belts

- V-toothed belt, quiet belt reduces the noise produced by the “whirring” of chains or toothed belts
- Replace chains with belts where possible
- Belts aren’t as durable but if a chain is causing too noise than belts are a possible alternative

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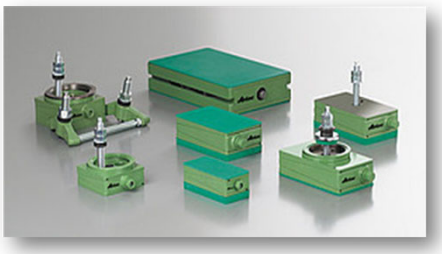
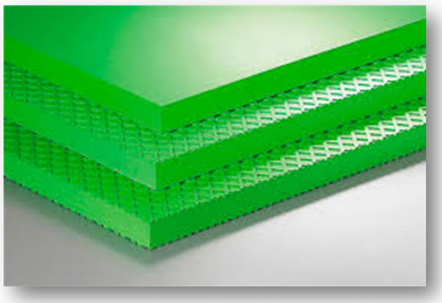
Isolation Mounts

Photo courtesy of Memtech Acoustical





Note: MIOSHA does not endorse any product.

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Air Noise Controls (continued)

Note: MIOSHA does not endorse any product.

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Stamping Machines

Photo courtesy of Memtech Acoustical

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Option 3. Block the noise

- Creating a barrier between the noise source and the environment so that the noise is contained within a controlled region
- Placing a well-designed enclosure (if possible) around the noise source will block a majority of the noise
- Extremely loud machines will require a hard acoustical enclosure in most cases
- In the situation where high noise sources are located within a close proximity to each other, it may be more cost efficient to acoustically isolate that section of the building and spare those working in other areas
- Using an enclosure is the most typical solution used in industrial settings

Sound Transmission Class (STC)

- Rating that shows the acoustic loss through a material. Often broken down by frequency. Often specified as a function of frequency.
- For example: The STC value of mass loaded vinyl (MLV) Barrier is 26 dB meaning that a noise will be reduced overall by about 26 dB when travelling through the barrier.
- It is about 26 dB because it depends on the frequency being attenuated.
- 125Hz – 13dB
- 250Hz – 17dB
- 500Hz – 22dB
- 1kHz – 26dB
- 2kHz – 32dB
- 4kHz – 37dB

These values average together to a total STC of 26dB

Mass Loaded Vinyl (MLV) Barrier

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

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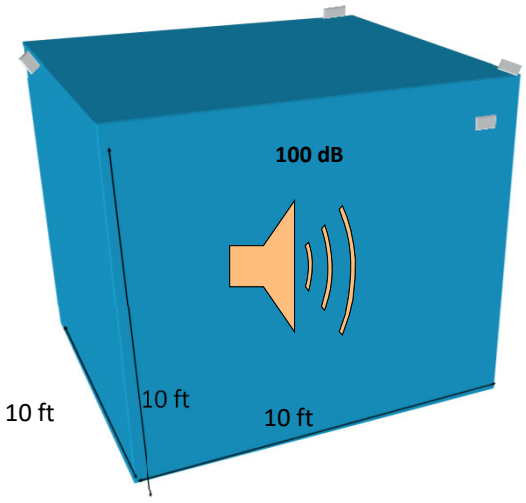
The Basics



- Imagine this box is 100% effective sound absorbing material
- No noise can escape this wonder material no matter what dB value or frequency
- 10 ft X 10 ft X 10 ft size
- Internal speaker generates 100 dB
- Four holes are cut into this perfect enclosure, on each side, each measuring 4” X 9”
- What is the noise outside the enclosure?

ANSWER : approximately 85 dBA

Drawing courtesy of Memtech Acoustical

72

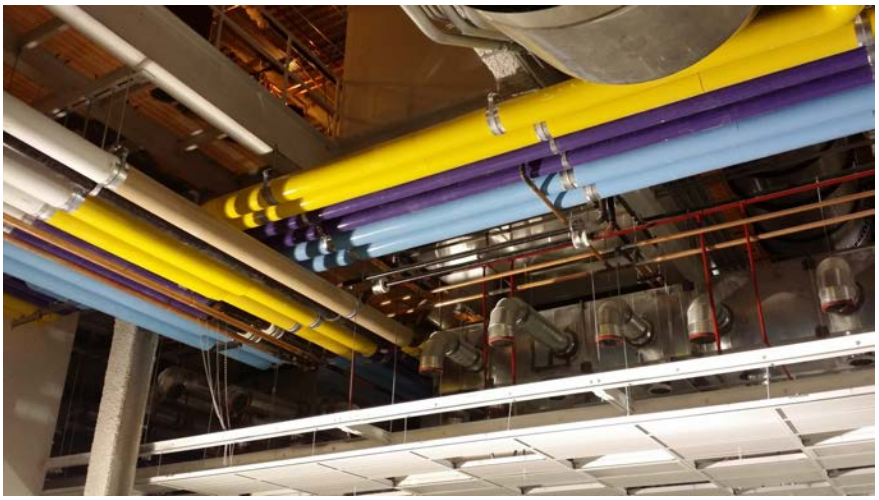
Heat Exchangers

Photo courtesy of Memtech Acoustical

73

73

Vibrating/Howling Pipes



74

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Enclose Operator Inside Booth

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

75

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Flexible Enclosures (Machine or Operator)

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

76

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Small Operator Control Booth

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

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Option 4. Absorb the Noise

- If a room is loud and reflective, reverberation may be a significant contributor to the overall noise level
- Acoustical material may be required to absorb the reverberations
- Acoustical foam is used within the room to reduce noise energy and absorb echoes
- Acoustical foam can be applied to the ceiling, walls, or is hung in open space
- As a result, the noise from reverberations are absorbed and the ambient level of the room is reduced
- By reducing the noise energy in a room to a minimum it results in a safer and more productive working environment

78

Reflective Rooms

Photo courtesy of Memtech Acoustical

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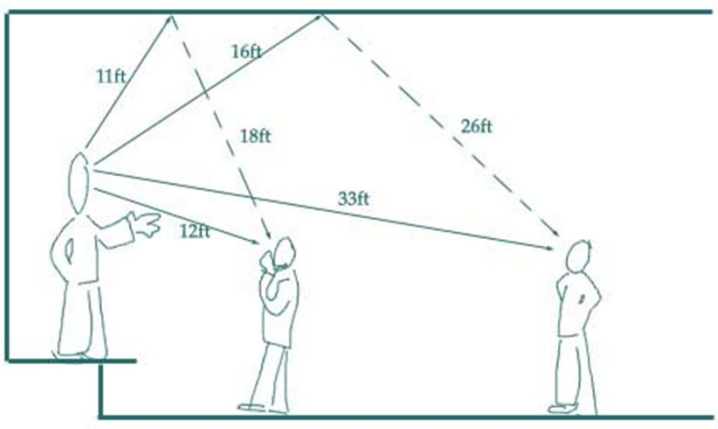
Direct vs Indirect



Direct noise dominates

80

80

Ceiling Baffles

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

81

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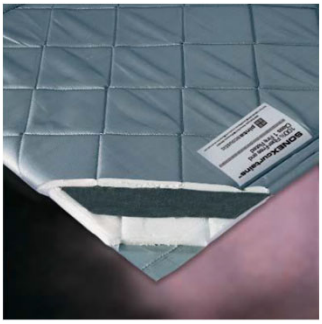
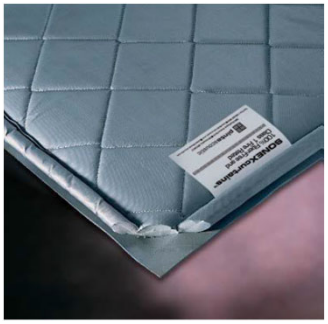
Quilted Noise Absorber





Photos courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

82

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Absorbing Material - Examples

Photos courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

83

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Foam Composites (Used to wrap pipes, line ducts, and line the inside of cabinets)

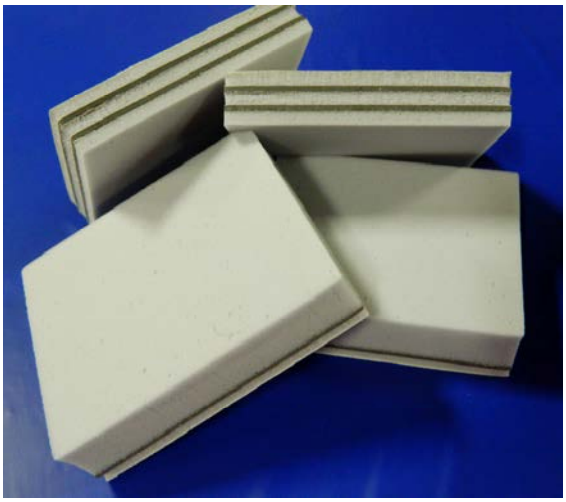

Photo courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

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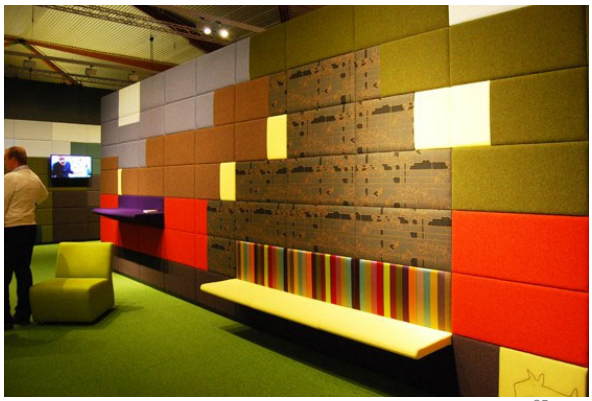
Decorative Noise Reduction Panels



Photos courtesy of Memtech Acoustical

Note: MIOSHA does not endorse any product.

85

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Reducing Hearing Conservation Program (HCP) Costs

- Eliminating the need for an HCP can save money in the following ways:
  - Reduce/eliminate buying hearing protection and the need to clean up the improperly disposed ear plugs
  - Eliminate costs associated with conducting annual audiometric testing and retests
  - Reduce/eliminate MIOSHA Part 380 noise citations
  - Costs to administer the HCP program
- Cost savings would be **$200-$300**/employee annually
- Lower insurance premiums

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Can you share your own Industrial Noise Control Success Stories or Current Challenges?

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Audiometric Testing Program

Audiograms, Standard Threshold Shifts, and Recordability

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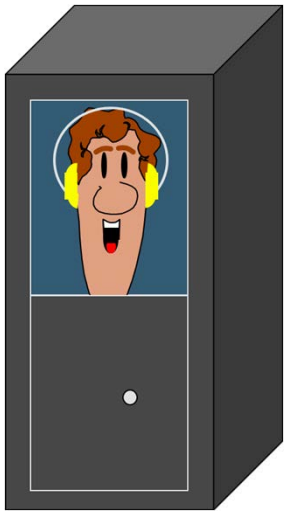
Audiometric Testing Program

- i.e. Hearing test
- Used to determine whether there is a loss of hearing
- Completed in a room or booth meeting appropriate sound level criteria



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Audiometric Testing Program (continued)

- All exposed at or above the action level (85 dBA)
- Provided at no cost
- Performed by licensed or certified:
  - Audiologist
  - Otolaryngologist
  - Any other physician
  - Technician
    - Certified
    - Demonstrates competency

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Audiograms

- Baseline
  - Within six months of first exposure at or above the action level (AL)
  - Mobile test vans:
    - Up to one year after first exposure
    - Hearing protection required if more than six months post exposure
  - Preceded by at least 14 hours without exposure to excessive workplace noise or non-occupational noise
- Annually for those exposed at or above AL

91

What is a Standard Threshold Shift (STS)?

A change in the hearing threshold **relative to the baseline** audiogram of an **average of 10 dB or more at 2000, 3000, and 4000 Hz** in either ear.

- Permanent STS
- Temporary shift (TTS)

≥ 10 dB

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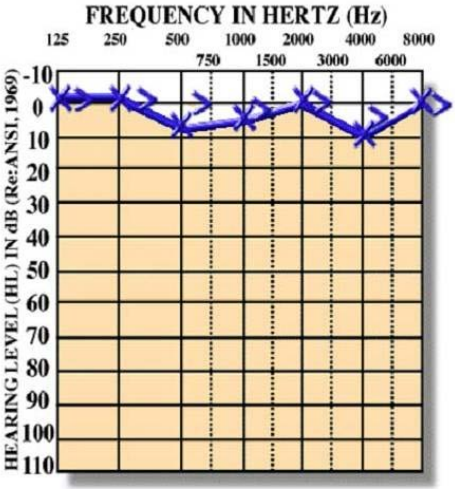
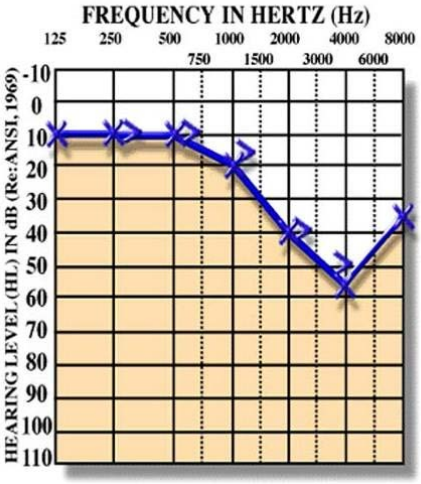
Baseline Audiogram



Standard Threshold Shift



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Determining an STS

- **Example: 35-year-old male and baseline audiogram when 28**

Frequency	Baseline at 28	Annual at 35	Change
2000 Hz	0 dB	10 dB	10 dB
3000 Hz	5 dB	15 dB	10 dB
4000 Hz	10 dB	25 dB	15 dB

$$\frac{(10 + 10 + 15)\ \text{dB}}{3} = 11.67\ \text{dB}\ (\geq 10\ \text{dB, therefore likely a STS})$$

Michigan Department of Labor & Economic Opportunity

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What about hearing loss that occurs just due to aging?

- In determining whether a standard threshold shift (STS) has occurred, an allowance can be made, to reflect the contribution of aging, associated with the change in an employee's hearing level.
- **NOTE:** This allowance considers both age and gender.

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Age Correction to an STS *(refer to app. F)*

- **Example: 35-year-old male employee and baseline when 28**

Frequency	Change	Correction at 28	Correction at 35	Correction Difference
2000 Hz	**10 dB**	4 dB	5 dB	1 dB
3000 Hz	**10 dB**	6 dB	8 dB	2 dB
4000 Hz	**15 dB**	8 dB	11 dB	3 dB

$$\frac{((10 - 1) + (10 - 2) + (15 - 3))\ \text{dB}}{3} = \frac{(9 + 8 + 12)\ \text{dB}}{3} = 9.67\ \text{dB}\ (< 10\ \text{dB}$$

therefore, **not an STS**)

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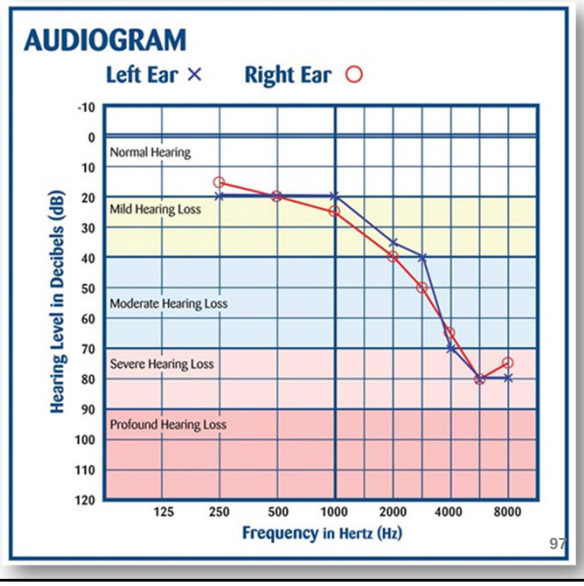
Evaluation of Audiograms

- Employer may retest employee within **30 days** to verify an STS.
- An audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation.



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Audiometric Testing

- Verify
  - STS(s) are not being under-reported
    - Compare the change in the employees' annual audiogram, relative to the employees' baseline audiogram, averaged across **the 2000, 3000 and 4000 Hz test frequencies.**

      Is the average difference more 10dB or more in either ear?

  - STS(s) determined to be from medical causes rather than occupational causes

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Follow up Procedures

If there is a Standard Threshold Shift:

- Notify employee **in writing within 21 days**
- Unless a **physician** determines that the standard threshold shift is not work-related or aggravated by occupational noise exposure, the employer shall ensure that all of the following steps are taken:
  - **Requires use of PPE!**
  - Refitted and retrained
  - Referred for additional testing as appropriate
  - Medical problem unrelated to hearing protection

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When is an STS Recordable?

An STS is recordable on the MIOSHA 300 Log if:

- **Meets STS criteria** – see previous slide

AND

- Hearing level is **≥ 25 decibels (dB)** **above audiometric zero** (as averaged at 2000, 3000, and 4000 Hz)

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Example of a Non-recordable Threshold Shift

- **Example: baseline and annual audiograms for each ear**

Audiogram	2000	3000	4000	Total
Baseline – Right Ear	5	5	5	15
Annual – Right Ear	5	5	5	15
Baseline – Left Ear	5	5	5	15
Annual – Left Ear	20	20	20	60

Right Ear: $\frac{(15 - 15)\ dB}{3}$ = 0 dB (< 10 dB, therefore not a STS)

Left Ear: $\frac{(60 - 15)\ dB}{3}$ = 15 dB (≥ 10 dB, therefore likely a STS)

Annual Left Ear: $\frac{60\ dB}{3}$ = 20 dB (< 25 dB, therefore not recordable)

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Example of a Recordable Threshold Shift

- Example: baseline and annual audiograms for each ear

Audiogram	2000	3000	4000	Total
Baseline – Right Ear	15	15	15	45
Annual – Right Ear	25	25	25	75
Baseline – Left Ear	15	15	15	45
Annual – Left Ear	15	15	15	45

Left Ear: $\frac{(45 - 45)\ dB}{3}$ = 0 dB (< 10 dB, therefore not a STS)

Right Ear: $\frac{(75 - 45)\ dB}{3}$ = 10 dB (≥ 10 dB, therefore likely a STS)

Annual Right Ear: $\frac{75\ dB}{3}$ = 25 dB (≥ 25 dB, therefore recordable)

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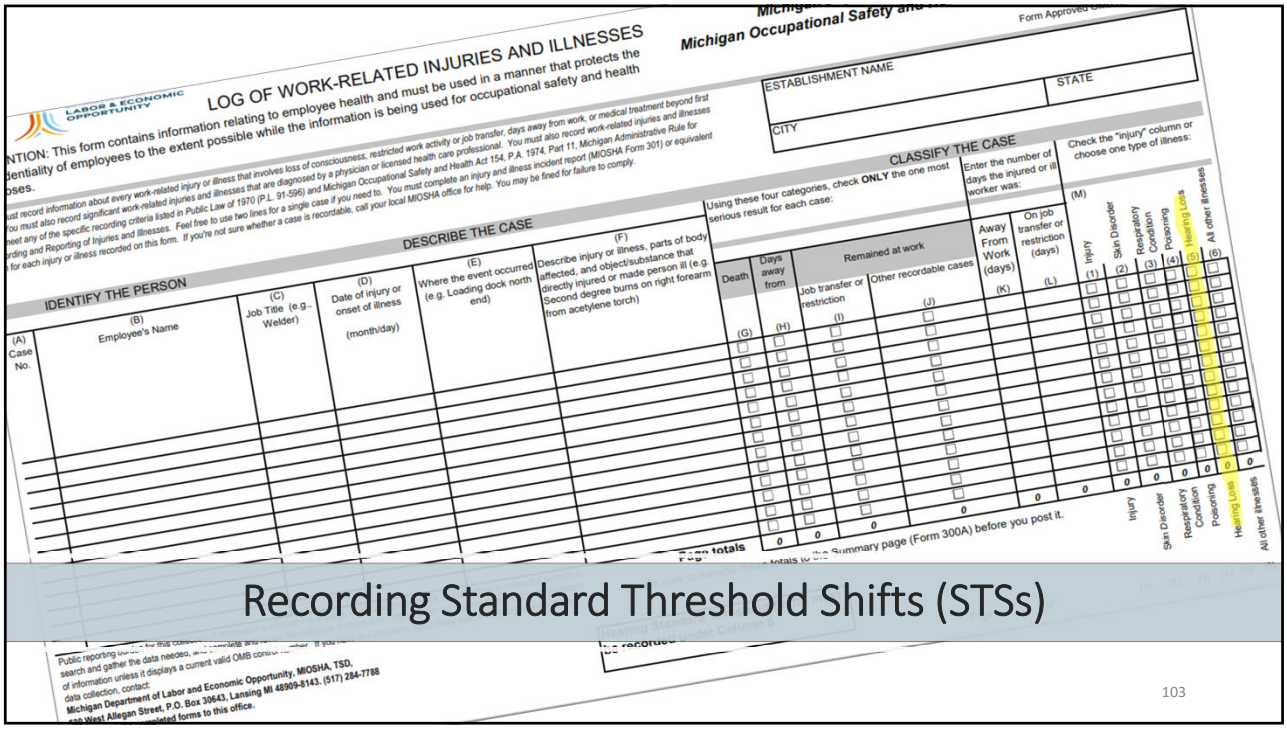

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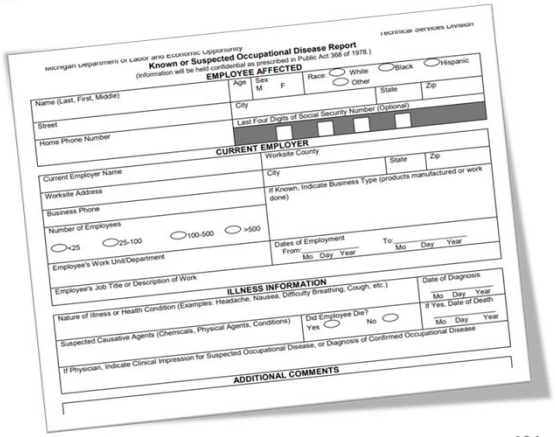
Occupational Disease Report – Used for Reporting Occupational Diseases

- Includes employee, employer and illness information
- Submit report within ten days after its discovery
- Report can also be submitted on-line

  www.michigan.gov/recordkeeping



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Practical Exercise:
Your turn to analyze an audiogram

- Use the sample audiogram to determine whether an STS has occurred.
- Also, determine the age-corrected STS.
- Then, if there is a STS, is it recordable?

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Audiometric Testing (continued)

- Verify
  - Booth or room sound pressure levels do not exceed any of the levels listed in the Standard (1910.95- Appendix D)
  - Functional operation check of audiometer is performed before each day's use
  - An acoustical calibration of audiometer is performed annually (1910.95 – Appendix E)
  - An exhaustive calibration is performed every two years

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Audiometric Test Requirements

- Describe requirements for audiometric testing equipment; including equipment calibration
- Audiometric examination test frequencies shall include, at a minimum, **500, 1000, 2000, 3000, 4000, and 6000 Hz**
- Tests at each frequency shall be taken separately for each ear

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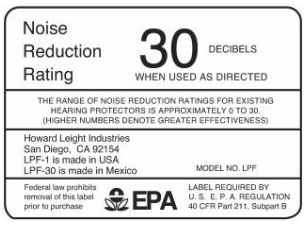
Noise Reduction Rating (NRR)

- NRR is a rating determined in a lab, assigned to a specific type of hearing protector, indicating the level of protection offered by the hearing protector
- Usually indicated by the manufacturer of the device on the packaging
- Examples
  - Ear plugs = 12 – 36
  - Ear muffs = 18 – 31



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Hearing Protector Attenuation (1910.95 – Appendix B)

Lp = Level of Protection

TWA = Noise Exposure averaged over eight-hours

NRR = Noise Reduction Rating of protective device

Lp = TWA - (NRR - 7)

(After calculation, the Lp should reduce exposure to 90 dB or less (< 85dB if employee has an STS))

NIOSH recommends that the manufacturers labeled NRR be derated

(Earmuffs: - 25%, Formable earplugs: -50%, All other earplugs: - 70%)

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Level of Protection (Lp) - PRACTICE

Lp = TWA - (NRR - 7)

- Eight-hour TWA = 106 dBA
- NRR = 26

Lp = [106 – (26 – 7)] dB

= [106 – 19] dB

= 87 dB

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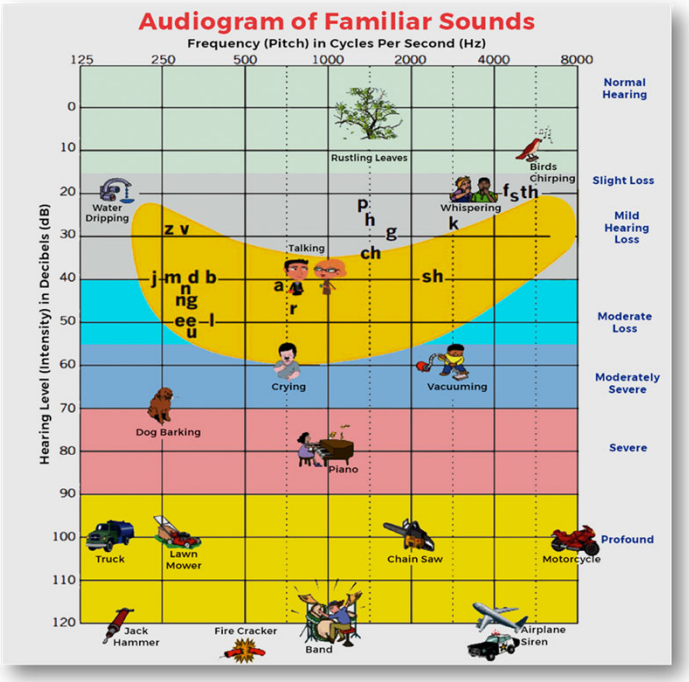
Hearing Loss and Speech Intelligibility



111

Activity – Hearing Loss Demo

“Say What…..?” An Introduction to Hearing Loss

American Academy of Audiology

www.audiology.org

Instructor plays:

Track 3

Track 4

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Employee Training

- Provide to all exposed at or above the action level
- Repeat at least **annually**
- Content:
  - Effects of noise on hearing
  - Purpose, selection, fitting, use, and care of hearing protectors
  - Purpose of, and procedures for, audiometric testing

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Access to Information and Training Materials

- ***Post*** copy of the Standard
- Make the Standard available to all employees
- Provide the employer's information and training materials to MIOSHA upon request

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Recordkeeping

Keep records of:

- Employee exposure measurements
- Employee audiograms
- Background sound pressure levels in audiometric test rooms
- Employee training (recommendation)

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Records Retention; Provision; Access; Transfer

- Noise exposure records - at least two years
- Audiometric tests - **duration of employment**
- Provide required records to MIOSHA upon request
- If company is purchased or merged – new company shall maintain records as described above

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Additional / Unusual Issues

- Radios too loud
- Loud headphones over the earplugs
- Employee who is legally deaf – hearing protection???

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Part 380 (1910.95) - Appendices

Mandatory:
- Appendix A – Noise Exposure Computation
- Appendix B – Estimating the Adequacy of HP Attenuation
- Appendix C – Audiometric Measuring Instruments
- Appendix D – Audiometric Test Rooms
- Appendix E – Acoustic Calibration of Audiometers

Non-mandatory:
- Appendix F – Calculations and Applications of Age Corrections to Audiograms
- Appendix G – Monitoring Noise Levels (Informational Appendix)

Reference:
- Appendix H – Availability of Referenced Documents
- Appendix I - Definition

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Part 380. Occupational Noise Standard – Most Common Violations

1. Most common is not having an HCP when noise exceeds the action level.
2. Not requiring hearing protection above permissible noise exposure limit (PNEL).
3. Not providing follow-up training and/or requiring HP when STS occurs.
4. Not implementing a noise monitoring program.
5. Not utilizing engineering or administrative controls to reduce noise below 90 dBA.

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Summary

- Explained the requirements of MIOSHA's Part 380. Occupational Noise Exposure Standard
- Conducted "hands-on" noise monitoring using noise dosimeters with actual noise sources
- Described what a Standard Threshold Shift (STS) is and when it must be recorded on MIOSHA Injury and Illness Logs
- Determined how to select and use appropriate hearing protection

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Assessment

- The purpose of this assessment is to validate the knowledge learned in class.
- Passing score of 70% correct is required.
- Class reference materials/books are not allowed to be used during the assessment.
- Collaboration/discussion with others is not allowed during the assessment.
- Answers will be reviewed after everyone completes and submits their assessment.

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Thank you.

Don't Forget to Take the Survey

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Part 380. Occupational Noise Exposure

Student Resources

MIOSHA Standards:
Part 380. Occupational Noise Exposure (29 CFR 1910.95)
Part 11. Recording and Reporting of Occupational Injuries and Illnesses

MIOSHA Fact Sheet: Noise & Hearing Conservation

MIOSHA CET Handouts:
Summary of Occupational Noise Exposure (CET-5600)
Requirements for Audiometric Testing Facilities (CET-5601)
Hearing Loss Prevention Programs (CET-5620)
Noise Information & Training (CET-5621)
Saw Blades – Noise Controls (CET-5680)
Stamping Press Noise Controls (CET-5681)
Screw Machines – Noise Controls (CET-5682)

OSHA Technical Manual:
Section III: Health Hazards, Chapter 5. NOISE [Updated 08/15/2013] – Contains a lot of helpful information.
Appendix K – Three Ways to Jump-Start a Noise-Control Program (shows examples of effective of engineering controls).

Other Resources

Noise Engineering Controls - Industrial Noise Control Handout
This handout lists some Michigan based companies (vetted in 2016) who can assist employers looking to install noise engineering controls and/or reduce noise levels.

E-A-R Aearo Technologies (a 3M Company)
https://earglobal.com/en/about-aearo-technologies-llc/engineering-and-design-assistance/
This site makes available informational white papers (i.e. Four-Fold Method of Noise and Vibration Control)

OSHA Letters of Interpretations:
OSHA policy regarding adjustments of Action Level for extended work shifts [11/10/1999]
Whether the noise standard is adjusted for work-shifts greater than 8 hours [3/26/1982]
OSHA interpretation sampling impulse noise [04/01/91]

Ask MIOSHA:
Listening to Headphones at the Worksite
Audiometric Testing Requirements

Michigan Department of Labor and Economic Opportunity
Michigan Occupational Safety and Health Administration
Consultation Education and Training Division
525 W. Allegan St., P.O. Box 30643
Lansing, Michigan 48909-8143

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call 517-284-7720
or
visit our website at www.michigan.gov/miosha

www.michigan.gov/leo