

# Noise & Hearing Conservation

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# Physics of Sound

- Sound stimulates our sense of hearing.
- It is an acoustic wave that results when a vibrating source, such as machinery, disturbs an elastic medium, such as air.
- In air, sound can be described as variations of pressure above and below atmospheric pressure.





# Hearing

- Hearing sensitivity is greatest in childhood, but as we get older, our perception of high tones worsens, a condition called “presbycusis”.
- The frequency range of the human ear extends from as low as 16 Hz to as high as 30,000 Hz.
- From a practical standpoint few adults can perceive sounds above 11,000 Hz.

# Hearing Loss

- Conductive Hearing Loss
  - Any condition that interferes with the transmission of sound to the cochlea (inner ear). Can sometimes be repaired.
  - Causes: wax in the outer ear, large perforation in the ear drum, blockage of the eustachian tube, fluid in the middle ear, otosclerosis, interruption of the ossicular chain due to trauma or disease.



# Hearing Loss

- Sensorineural Hearing Loss (noise induced)
  - The loss of sensory component (organ of Corti) and degeneration of the neural elements of the auditory nerve. Almost always permanent.
  - Caused by exposure to excessive noises. Damage to hair cells is of critical importance to noise-induced hearing loss. May also be a result of presbycusis, viruses (mumps), congenital defects and drug toxicity (streptomycin).

# Hearing Loss

- Mixed Hearing Loss
  - Components of both conductive and sensorineural hearing loss in the same ear.
- Central Hearing Loss
  - Implies difficulty in a person's ability to interpret what is heard. Usually caused by an abnormality in the brain.
- Psychogenic Hearing Loss
  - Indicates a non-organic basis for the loss such as hysteria.



# Instrumentation

- Sound Level Meter (SLM)
  - Used to:
    - Determine need for dosimeters
    - Aid in determining the feasibility of engineering controls
    - Evaluate hearing protection.
- Octave Band Analyzers generally not used unless
  - Engineering controls for noise reduction and hearing protection devices.
  - Divides noise into its octave bands

# Instrumentation

- Dosimeters
  - Measures sound levels just like the SLM.
  - Averages sound levels to provide a time weighted average sound level.
  - Used for compliance measurements to determine the need for a hearing conservation program.
  - Dosimeters must meet certain criteria (ANSI) to be acceptable and is **+/- 2dB**.
  - Microphone must be placed in the employee's hearing zone (OSHA defined as a **two foot diameter** surrounding the head).
  - Compliance settings are dBA and slow.









# Common Sound levels

Activity	dB	N/m <sup>2</sup>
Quiet Room	40	0.002
Conversation	60-75	0.02
Vacuum Cleaner	70	0.07
Diesel Truck (40')	85	0.4
Lawn Mower	90	0.7
Rock Concert	110-140	7
Pneumatic Chipper	115	15

# Noise Regulations

- 29 CFR 1910.95 – Occupational Noise Exposure for General Industry
- 29 CFR 1926.101 - Occupational Noise Exposure for the Construction Industry
- 29CFR 1926.101 – Hearing Protection for the Construction Industry



# Occupational Noise Exposure 29CFR1910.95

- **Two Parts**
  - **Noise Regulation**
  - **Hearing Conservation Amendment to the Noise Regulation**
- **This Noise Regulation has been in place when OSHA Act was passed & HCA was promulgated in 1983**
- **Regulates the exposure of employees to occupational noise.**
- **The employer **must require** protection against the effects of noise when sound levels exceed limits listed in Table G-16.**

# Table G-16

Duration per day (hrs)	PEL (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
.5	110
.25 or less	115



# Key Elements of a Hearing Conservation Program

- **Monitoring**
- **Employee Notification**
- **Observation of Monitoring**
- **Audiometric Testing**
- **Hearing Protection**
- **Training**
- **Recordkeeping**

# Administrative and Engineering Controls

- Feasible controls - exceed permissible noise exposure levels.
- Hearing protection allowed if engineering controls are not feasible



# Hearing Conservation Program

- A written program is not required by the regulation but helpful.
- Hearing conservation program required whenever employee exposure equals the Action Limit (AL).

# Noise Monitoring Requirements

- Monitoring required when information indicates employee's exposure may equal or exceed the Action Level.
- Sampling Strategy?
  - SLM is not usually the best
  - Dosimeter monitoring
- Noise measurements must integrate all continuous, intermittent and impulsive noise levels from 80-130 dBA.



# Noise Monitoring

- Noise Dosimeters are generally two channel units.
  - Hearing Conservation Dosimeter
    - Starts at 80dBA (threshold level)
    - A-weighting and slow response
    - 5 dB doubling
    - 100% dose is 90dBA

# Noise Monitoring

- **Noise Regulation Dosimeter**
  - **A-weighting and slow response**
  - **Begins to see noise at 90dBA (Threshold)**
  - **5 db doubling**
  - **100% dose is 90 dB**



# Important to Remember

- Action Level is adjusted for work period
  - 8 hours = 85dBA
  - 10 hours = 83.4dBA
  - 12 hours = 82.3dBA
- Derived from this formula
- $AL = 16.61 \text{Log}_{10} [50 / (12.5 \times \text{hours worked})] + 90$

## Notification and Observation of Monitoring

- **Monitoring should be repeated when there is a change in noise**
- The employer must notify each employee who is exposed at or above the Action Level.
- The employer must provide affected employees or their representatives with an opportunity to observe any noise monitoring conducted pursuant to the regulation.



# Audiometric Testing

- Provided at no cost to employees when their noise exposure equals or exceeds the Action Level.
- Tests performed by certified individuals.
- Audiograms must meet the requirements of Appendix C. Mobile test vans are allowed.
- A valid baseline must be established within 6 months of the initial exposure at or above the Action Level (1 year for mobile test vans).

## Audiometric Testing (cont.)

- Testing proceeded by at least 14 hours without exposure to workplace noise. (Hearing protectors can be used to fulfill requirement.)
- Employer must notify employee about need to avoid high noise exposures for 14 hours prior to test.
- A new audiogram must be obtained at least annually after the initial audiogram.



# Standard Threshold Shift (STS)

- Annual audiograms must be compared to baseline to determine if they are valid and if standard threshold shift has occurred.
  - Change in hearing threshold relative to the base line audiogram of an average of 10 dB or more at 2000, 3000 or 4000 Hz in either ear.
  - Allowance may be made for presbycusis by using Appendix F.
- If the annual shows an STS, the employer can obtain a retest within 30 days and consider the retest results as the annual audiogram.
- The audiologist, Otolaryngologist or physician shall review problem audiograms and determine if there is a need for further evaluation.

# STS (continued)

- Requirements if STS occurs.
  - Employee must be notified within 21 days of determination.
  - Hearing protection fitted, employee trained and use required if not already used.
  - Employees already using hearing protection must be refitted, retrained and required to use hearing protection with greater protection than they were using.
  - Clinical audiological examination may be required.
  - If subsequent audiograms show the STS is not persistent:
    - Employee should be notified of new interpretation.
    - Hearing protection for that individual no longer required.



## STS (continued)

- An annual audiogram can be substituted for the baseline audiogram if:
  - The STS is determined to be persistent.
  - The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.
- The regulation contains specific requirements for how tests are conducted, the types of audiometers that can be used, test room requirements and calibration requirements. Employers must ensure that these requirements are met for testing.

# Hearing Protection

- Hearing protection provided at no cost to employees exposed at or above the Action Level.
- Employers must ensure that hearing protection is worn.
  - Where feasible administrative or engineering controls fail to reduce exposures to less than the limits in Table G-16.
  - Where exposures exceed the action level and
    - Has not had a baseline audiogram established, or
    - Has had a standard threshold shift.



# Hearing Protection

- Employees must be given choice for their hearing protection devices from a suitable variety.
- The employer shall provide training in the use and care of any hearing protectors provided to employees.
- The employer must ensure employees are properly fitted to start and supervise the correct use of hearing protectors.

# Attenuation

- Attenuation refers to the decrease of noise levels as a result of wearing hearing protection.
- Employers must evaluate hearing protector attenuation for their specific noise environments using one of the evaluation methods described in Appendix B.
- Hearing protectors must attenuate exposure to at least 90 dBA (8 hour TWA) or 85 dBA for employees with an STS.
- Adequacy of attenuation must be reevaluated when noise exposure increases.



# Attenuation

- Noise Reduction Rating (NRR), EPA requires NRR to be shown on the hearing protection device package.
  - Method 1
    - Obtain employee's dBC for shift and convert to TWA
    - Subtract the NRR from the TWA.
  - Method 2
    - Obtain dBA for shift and convert to TWA
    - Subtract 7 from the NRR
    - Subtract the remainder from the TWA

## Training

- Training program required for all employees exposed at or above the Action Level. Employer must ensure employee participation.
- Training must be repeated annually for each employee in the hearing conservation program with information updated to reflect any changes in protective equipment and work processes.



- Training must include:
  - effects of noise on hearing
  - purpose of hearing protectors and attributes of the different types
  - purpose of audiometric testing and an explanation of the test procedures.

# Access to Information

- The employer must make the following available to affected employees or their representatives:
  - **A copy of the standard (a copy must also be posted in the workplace);**
  - Any informational materials pertaining to the standard provided by OSHA;
  - Upon request, all materials related to the employee's training and education program.



# Recordkeeping

- Accurate copies of noise exposure measurement records should be maintained for 2 years.
- Audiometric test shall be retained for the duration of the affected employees employment and include:
  - Name and job classification
  - Date of audiogram
  - Examiner's name
  - Date of the last acoustic or exhaustive calibration of the audiometer
  - Employee's most recent noise exposure assessment
  - Records of the background sound pressure levels in the measurement room

QUESTIONS?

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