Hearing Loss Prevention Programs

Individuals with hearing loss constitute the single largest disability group in America. Noise is the number one cause of hearing loss. Approximately 30 million workers are exposed to noise levels or toxicants that are potentially hazardous to their hearing. Fortunately, noise-induced hearing loss can be reduced through the application of occupational hearing loss prevention programs (HLPP).

A successful hearing loss prevention program benefits both the company and affected employee. Employees are spared disabling hearing impairments, and evidence suggests that they may experience less fatigue and generally better health. Ultimately, the company benefits from reduced medical expenses and worker compensation insurance. In some cases there may be improved morale and work efficiency.

However, an employer can comply with the occupational health noise rules while employees continue to suffer from noise-induced hearing loss. For this reason, emphasis on *prevention,* rather than *conservation*, reflects a belief that hearing loss is avoidable. This document presents the seven important elements of successful hearing loss prevention programs:

1. Noise exposure monitoring
2. Noise control process
3. Hearing protection
4. Education and notification
5. Audiometric evaluation
6. Record keeping
7. Program evaluation

A Hearing Conservation Program is a part of a HLPP and includes program elements 1 through 6. A Hearing Conservation Program is mandatory for all employers in Michigan whose employees are exposed to excessive noise levels, as defined in the MIOSHA Part 380 *Occupational Noise Exposure* standard.

1. Noise Exposure Monitoring

An employer is responsible for identifying employees who are exposed to noise. Noise exposure monitoring must be conducted for various purposes:

1. Determining whether hazards to hearing exist
2. Determining whether noise presents a safety hazard by interfering with speech communication or recognition of audible warning signals
3. Identifying employees for inclusion in the hearing conservation program
4. Making priorities for noise control efforts and establishing hearing protection practices
5. Identifying specific noise sources for the implementation of engineering controls
6. Evaluating the success of noise control efforts

Various types of instruments and measurement methods may be used to perform noise surveys. The most common types of noise measurement instruments include sound level meters, noise dosimeters, and octave band analyzers. A noise dosimeter is a sound level meter that integrates (averages) sound levels over time and an octave band analyzer measures sound levels at particular frequencies. Sound level

Note: This document is intended to provide guidance for good practices to avoid hearing loss. It is not intended to be a summary of the MIOSHA Occupational Noise Exposure Standard.

meters and dosimeters are used to characterize sound sources for engineering controls and detailed hearing protection evaluation.

Dosimetry involves the use of body-worn instruments (dosimeters) to monitor an employee's noise exposure over the work shift. The microphone is positioned on the shoulder in the *hearing zone* of the wearer. The wearer goes about the normal work shift while wearing the dosimeter. Hearing zone hand-held sound measurements produce valuable exposure information.

Monitoring results for one employee can represent the exposures of other workers in the area whose noise exposures are similar. Exposure monitoring should be repeated whenever there is a change in equipment, production processes or maintenance routines. It may be necessary to assess noise exposure when work practices and/or shift durations change or when workers develop Standard Threshold Shifts (see Audiometric Evaluation section).

Instruments used to measure workers' noise exposures must be calibrated to ensure measurement accuracy and must conform to the American National Standards Institute (ANSI) *American National Standard Specification for Personal Noise Dosimeters*, ANSI S1.25-1991 (R1997). In determining eight-hour time-weighted average (TWA) exposures, all continuous, varying, intermittent and impulsive sound levels from 80 to 140 dB shall be integrated into the noise measurements. The sound level meter or dosimeter settings must be set at SLOW response and use the "A" weighted scale. Further information on noise exposure monitoring can be found in the publication ANSI S12.19-1996 *Measurement of Occupational Noise Exposure*.

Noise Exposure Monitoring Results- The following table describes the requirements of the hearing conservation program with recommendations for an effective HLPP.

If a worker's noise exposure…	**Then… (Action by employer)**
…is below the "action level"(85 dBA TWA)	**Nothing. Recommend use of hearing protection when exposure is greater than 80 dBA TWA.**
…equals or exceeds the "action level" (85 dBA TWA), but does not exceed 90 dBA TWA ****MANDATORY****	• **Enroll the worker in a hearing conservation program including exposure monitoring** • **Provide hearing protectors** • **Ensure that the hearing protectors are worn if the worker has a standard threshold shift or it will be longer than six months before receiving a baseline audiogram.**

If a worker's noise exposure…	**Then… (Action by employer)**
… equals or exceeds the 90 dBA TWA ****MANDATORY****	• **Hearing protection required** • **Hearing conservation program required** • **Feasible engineering and administrative controls must be implemented when 90 dBA is exceeded**

The "action level" is triggered when employee exposure exceeds 85 dBA TWA. The permissible Noise Exposure Limit or "PNEL" is 90 dBA TWA.

2. Noise Control Process

MIOSHA standards emphasize elimination of hazards by requiring employers to implement feasible engineering controls. MIOSHA Enforcement's expectation is that feasible engineering controls shall be implemented when the PNEL exceeds 100 dBA. Engineering controls are defined as any modification or replacement of equipment or related physical change at the noise source or along the transmission path (with the exception of hearing protectors) that reduces the noise level. Noise exposures can be lowered or eliminated by identifying existing feasible controls; planning to purchase quiet, new and rebuilt equipment; and considering noise control as part of a preventative maintenance program. The three elements of a successful noise control process are summarized as *Buy-It-Quiet, Make-It-Quiet and Keep-It-Quiet*.

Buy-It-Quiet: It is important that companies specify low noise levels when purchasing new equipment. Many types of previously noisy equipment are available in noise-controlled versions. The design stage of the equipment provides the best opportunity for noise reduction. Equipment manufacturers should be charged with designing quiet machinery through the establishment of an effective "buy quiet" purchase policy. Factors to consider in using a "buy quiet" specification include:

- Make sure that the specification is referenced in all requests for quotation and make compliance with the specification a requirement.
- Request that quotations address noise controls separately, with detailed descriptions and costs.
- Review and approve proposed controls with appropriate personnel prior to the award.
- Maintain documentation of noise control work including letters, sketches and measurements.

The "buy quiet" specification goal should be less than 80 dBA at the operator's workstation. Further information regarding *But-It-Quiet* specifications can be found in the American National Standards Institute document ANSI S 12.16-1992 (R1997) *Guidelines for the Specification of Noise of New Machinery.*

Make-It-Quiet: The second element of the Noise Control Process addresses noise reduction of existing equipment through an *action plan*. The action plan should include the following elements:

Identification- A noise level survey of equipment, in conjunction with employee exposure data, will identify equipment to be targeted.

Evaluation- A review of noise control options is necessary. The review should include sources of information regarding existing control technologies, employee experience, equipment manufacturers and acoustics specialists.

Classification- The noise control of targeted equipment is to be classified as *feasible, infeasible or indeterminate.* If feasible controls exist, a plan for implementation is required. If the noise control options are documented as infeasible, no further engineering control action is required unless there is some other benefit (i.e. ergonomic) to be gained. Indeterminate feasibility describes noise problems where there *may* be a control but the impact is not fully known and further study is required (i.e. developing a prototype).

Implementation Plan- Develop a plan of action that includes short-range project-type goals and on-going goals that require regular attention. The latter is discussed in the next section, *Keep-It-Quiet*. Prioritize the implementation plan:

1. Install feasible controls for noise sources contributing to employee exposures that exceed 90 dBA TWA.
2. Install controls where the greatest numbers of workers benefit.
3. Install feasible controls for noise sources contributing to employee exposures that are greater than 85 dBA TWA. This applies when the controls will reduce employee exposure by 5 dBA or to less than 85 dBA TWA.

Assign Responsibility- A written plan can be used to document the organization's commitment to implement engineering controls. A program administrator is responsible for assigning responsibilities and ensuring target goals are implemented. The following is an example plan:

RESPONSIBILITY	ACTION	TARGET DATE
Individual, Production Maintenance	Eliminate pneumatic exhaust noise on modules by installing quality exhaust mufflers or by piping exhausts into a plastic manifold with muffler.	Prints for # 2 manifolds due by June
Individual, Millwright Journeyman	Enclose saw station on machining line	Design due July
Individuals, Welder and Millwright Apprentices	Treat metal chutes with sound-deadening material and/or weld additional sheet metal to chutes for reduction of part impact noise	Work in progress to be completed by February
Individuals, Plant Engineer and Pipefitter Journeyman	Treat compressed air blow-offs on machine lines by installing blow-off silencer nozzles http://www.silvent.com/. Air blast timing and pressure will be adjusted after installation to amounts necessary to perform satisfactorily.	To be completed by April

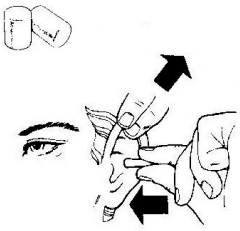
Keep-It-Quiet: The third element of a Noise Control Process involves on-going commitment to include noise controls into daily tasks. The process needs a support system to continue operating without daily conscious direction. Employees must understand the importance of maintaining and caring for the engineering controls. On-going standard practices for maintenance should include:

- A common-systems approach to controlling noise problems and communication protocols
- Integrating noise control practices into production and maintenance tasks
- Increasing awareness for noise control opportunities

To ensure the elements of the Noise Control Process are functioning as intended, a Noise Control Committee should be formed and *indices of program effectiveness* should be defined and tracked. These include reductions in noise exposure risk and incidence of Standard Threshold Shifts. Information on noise control can be found at https://www.cdc.gov/niosh/noise/.

3. Hearing Protection

When employees are exposed to sound levels at or exceeding the action level (85 dBA TWA) hearing protection devices (HPD) shall be provided. A pro-active Hearing Loss Prevention Program requires HPD use for all employees exposed at or exceeding the action level. Key factors to consider when purchasing HPD include: comfort, fit, and problems caused by over-attenuation such as communication difficulties and the inability to hear warning signals.



Formable Plugs - Slowly roll and compress foam plugs into a very thin cylinder. While compressed, insert plug well into the ear canal. Fitting is easier if you reach around the head to pull the ear outward and upward during insertion.

Premolded Plugs - Reach around the back of your head and pull outward and upward on the ear while inserting the plug until you feel it sealing. This may seem tight at first, especially if you've never worn earplugs.

Earmuffs – Muffs must fully enclose the ears to seal against the head. Adjust the headband so cushions exert even pressure around the ears to get the best noise reduction. Pull hair back and out from beneath the cushions. Don't store pencils or wear caps under the cushions.

Courtesy of EAR

Noise Reduction Rating (NRR) The selected hearing protector must be capable of keeping the noise exposure at the ear below 85 dBA. Several methods exist for estimating the amount of sound attenuation a hearing protector provides. In the United States, the NRR is required by law [40 CFR 211] to be shown on the label of each hearing protector sold. The short method of determining the effective level from use of a protector involves subtracting from the exposure level (dBA) the NRR less 7 (to account for conversion from dBC to dBA).

NIOSH recommends using subject fit data based on ANSI S12.6-1997 [ANSI 1997] to estimate hearing protector noise attenuation. If subject fit data are not available, NIOSH recommends de-rating hearing protectors by a factor that corresponds to the available real-world data. The National Institute of Occupational Health and Safety (NIOSH) recommends that the labeled NRRs be derated as follows:

Earmuffs	Subtract 25% from the manufacturer's labeled NRR
Formable Earplugs	Subtract 50% from the manufacturer's labeled NRR
All Other Earplugs	Subtract 70% from the manufacturer's labeled NRR

For example, an employee is exposed to 99 dBA TWA and wears formable (foam) earplugs with a listed NRR of 26 dBA. Application of the above guidelines gives an effective NRR of 13 dBA. The employee's real world exposure is 99 – 13 = 86 dBA TWA. In this case, hearing protection with a higher NRR rating or reduction of noise exposure is required.

It is important for employees to properly insert and fit earplugs to obtain the greatest protection possible. Consult the hearing protection manufacturer for information on proper training and fitting of HPD. The NIOSH Compendium of Hearing Protection Devices is available at https://www.cdc.gov/niosh/noise/.

4. Education and Notification

All workers who are exposed to noise at or above 85 dBA TWA shall be informed about the potential consequences of noise exposure and the methods of preventing noise-induced hearing loss. New workers shall be alerted to the presence of hazardous noise before they are exposed to it. MIOSHA requires that a copy of the Occupational Noise Exposure rules be posted in the workplace.

Training- The employer shall institute a training program in occupational hearing loss prevention for all workers who are exposed to noise at or above 85 dBA TWA. The training must be repeated annually for each worker enrolled in the program. The training must include:

1) The physical and psychological effects of noise and hearing loss
2) Hearing protector selection, fitting, use and care
3) Audiometric testing

The roles and responsibilities of both employers and employees in preventing hearing loss should be well defined. Workers who have demonstrated a Standard Threshold Shift shall be refitted and retrained in the proper use of hearing protectors. Details of health effects of excessive sound exposure can be found at https://www.cdc.gov/niosh/noise/.

5. Audiometric Evaluation

Occupational hearing loss occurs gradually and is typically not accompanied by pain. Audiometric evaluations, or hearing tests, are required to determine of occupational hearing loss has occurred. By comparing *baseline* and *annual audiograms*, threshold shifts are discovered and the beginning of hearing loss is detected. The purpose of audiometric testing is to trigger prompt protective measures and motivate employees to prevent hearing loss.

The baseline audiogram is the reference audiogram against which future hearing tests are compared. It must be provided within six months of an employee's first exposure at or above 85 dBA TWA (one year for mobile test van option). Annual audiograms must be conducted within one year of the baseline. The term Standard Threshold Shift (STS) describes an *average* change in hearing from the baseline audiogram levels of 10dB or more for the frequencies of 2000, 3000, and 4000 Hz. When a Standard Threshold Shift has been determined, the MIOSHA Occupational Noise Exposure rules require certain actions. These include a retest within 30 days, an evaluation of the adequacy of hearing protectors, and/or the requirement to use HPD. Audiograms should be performed on the following occasions:

- Pre-employment (baseline) and before initial assignment to a high noise area
- Annually when the employee is assigned to a job where the noise exposure exceeds 85 dBA TWA
- Reassignment out of a hearing hazardous job
- Termination of employment

Employers shall support audiometric evaluations by allocating sufficient resources. Mobile test providers or a local hearing clinic may contract audiometric services. A licensed audiologist, otolaryngologist or physician must be responsible for the program. This includes overseeing the work of technicians who administer the audiograms, reviewing problem audiograms, and determining whether a referral is necessary.

Program administrators must ensure that the reviewed audiometric record indicates:

1. The specific purpose of the audiometric examination: for example, baseline, annual, retest, threshold shift confirmation or other
2. The specific equipment used and most recent calibration date
3. The name of the tester
4. The date and time of day of the test (which work shift)
5. The auditory history information
6. The hearing threshold values obtained
7. The tester's judgment of the subject's response reliability
8. The results of the protector inspection and a record of any refitting, reissuing or retraining
9. The tester's comments, if any

Audiograms should not be given after the subject had been exposed to noise. For this reason, it is best to schedule hearing tests at the beginning of the work shift.

6. Recordkeeping

Hearing loss prevention program records should include documentation of all items for each element of the program:

1. Noise exposure monitoring
2. Noise control process
3. Hearing protection
4. Education and notification
5. Audiometric evaluation
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Noise exposure records shall be maintained for at least two years and audiometric test records shall be maintained for at least the duration of employment.

Part 11 *Recording and Reporting of Occupational Injuries and Illnesses* requires employers to record a work-related STS under Column five on the MIOSHA 300 Log if the employee's total hearing is 25 dB or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear as the STS. An example protocol for determining STS recordability (if at any step a "no" is encountered, the process ends and the hearing change is not recorded on the Form 300):

Step 1: Compare the original baseline audiogram or last audiogram showing a recordable shift in hearing. Is there an STS in either ear (age adjustments allowed)? If yes continue to Step 2.

Step 2: Is the average hearing level on the current hearing test at 2000, 3000, and 4000 Hz in the same ear greater than or equal to 25 dB HL (no age adjustment allowed)? If yes, continue to Step 3.

Step 3: Is the STS confirmed upon 30-day retest (or was a retest not conducted)? If yes, continue to Step 4.

Step 4: Record the case on MIOSHA Form 300 within seven days of retest (or within 37 days of test if retest is not conducted), unless a physician other licensed health care professional has determined that the shift in hearing is not work related (i.e. hearing loss has not been significantly aggravated by occupational noise exposure).

7. Program Evaluation

Hearing loss prevention programs require periodic evaluation to assure their effectiveness. A comprehensive hearing loss prevention checklist is available from the NIOSH document, *Preventing Occupational Hearing Loss*. The most current Hearing Conservation Checklist is available at https://www.cdc.gov/niosh/noise/

Employers, employees and other interested parties may obtain information about the MIOSHA Occupational Noise Exposure Standard by contacting the Consultation Education and Training (CET) Division, 530 W. Allegan Street, P.O. Box 30643, Lansing, MI 48909-8143, (517) 284-7720. Occupational health standards for general industry, including the MIOSHA Occupational Noise Exposure Standard are available online at www.michigan.gov/mioshastandards.

References

Assistance and information on the health hazards of noise, noise monitoring, audiometric testing and noise controls are also available from industrial hygienists, occupational safety and health consultants, audiometric testing services, audiologists and insurance carriers. A good overview of the nature and scope of noise and hearing is provided by the following documents:

Berger, E.H., Royster, L.H., Royster J.D., Driscoll, Layne, M. (Eds.)(2000). The Noise Manual. (5th) ed. Fairfax, VA: AIHA Press.

The following free publication is available from the National Institute for Occupational Safety and Health (NIOSH), 1(800) 35NIOSH:

U.S. Department of Health and Human Services Centers for Disease Control and Prevention NIOSH. (1998). Criteria for A Recommended Standard Occupational Noise Exposure. Cincinnati, OH. Publication No. 98-126.

Hearing Conservation Program administration guidelines and other references used in development of this summary:

Megerson, S.C. (2002). OSHA's Final Rule for Recording Occupational Hearing Loss. The Newsletter of the Council for the Accreditation in Occupational Hearing Conservation Update, 14(3), 1, 3, and 10.

Anderson, RR, Brogan, PA, (1994). "Industrial Noise Control Process", *National Hearing Conservation Association Annual Conference.*

Franks, JR, Stephenson, MR, and Merry, CJ (1996). "Preventing Occupational Hearing Loss- A Practice Guide," U.S. Dept. of HHS (NIOSH) Rept. 96-110.

Royster, JD and Royster, LH (1990). Hearing Conservation Programs: *Practical Guidelines for Success*, Lewis Pub., Chelsea, MI