Can You Hear Me Now?

Assessing noise exposure and implementing successful hearing loss interventions

By Louise Vallee, Michael Ruddy and Kristin Bota

Abstract: *Noise-induced hearing loss is 100% preventable. Workplace hearing conservation programs are a key frontline defense to identify and control the impact of noise-induced hearing loss. Gaps in these programs are missed opportunities to prevent hearing loss.*

NOISE HAS BEEN RECOGNIZED as an occupational hazard since the 1700s, but only recently has the additional impact of recreational source contribution across generations been revealed. Studies suggest that half of all baby boomers are experiencing some degree of hearing loss as a result of workplace and/or recreational noise sources. Additionally, they are hesitant to seek hearing testing and remediation measures, such as hearing aids (Trads & Glasscock, 2006).

With the advent of personal mobile telephones and music devices, generation X-ers and millenials, as well as boomers, are at additional risk for greater hearing loss than previous generations. Understanding of the impact of recreational noise on lifelong hearing is limited. Noise as unwanted sound is a by-product of many industrial operations. Noise as wanted or unwanted sound is an intended outcome or by-product of many recreational activities (Table 1). For example, attendance at a rock concert may result in exposures to loud but desirable sound, while target shooting results in loud, undesirable noise accompanying an enjoyed activity.

Noise-induced hearing loss is 100% preventable. Workplace hearing conservation programs are a key frontline defense to identify and control the impact of noise-induced hearing loss. Gaps in these programs are missed opportunities to prevent hearing loss. To identify and address those gaps, needed interventions include program audits, follow-up on problem audiograms and action plans. SH&E professionals can directly affect the success of these programs by focusing attention on hearing conservation program performance.

Noise: A Chronic Problem

Sound results from pressure changes in air due to vibration. Overexposure to noise, whether of industrial or recreational origin, results in hearing loss. Hearing loss can occur from exposure to a single, extremely loud event but more typically is a result of chronic or ongoing overexposure.

The extent of hearing loss depends on exposure loudness, duration and frequency. Chronic overexposure to noise can result in permanent hearing loss, called a permanent threshold shift (PTS). PTS can result from workplace or recreational noise sources. Noise-induced hearing loss can start out as a temporary effect from short-term exposure with recovery occurring after removal from the noise. This effect is called a temporary threshold shift (TTS) (NIOSH, 1998).

Hearing loss is insidious: irreversible and unrecognized detrimental effects develop over time with no precursor warning signals. Tinnitus, ringing in the ears, can also be experienced. Hearing loss makes it difficult to communicate with coworkers, family members and others, which can produce feelings of isolation. Overexposure to noise can result in stress-induced illness, high blood pressure and loss of sleep. Noise and hearing loss in the workplace causes reduced safety awareness and increased accident potential. Distracting and excessive noise levels are linked to lowered productivity, both in industrial and office settings (CCOHS, 2008; EPA, 2009).

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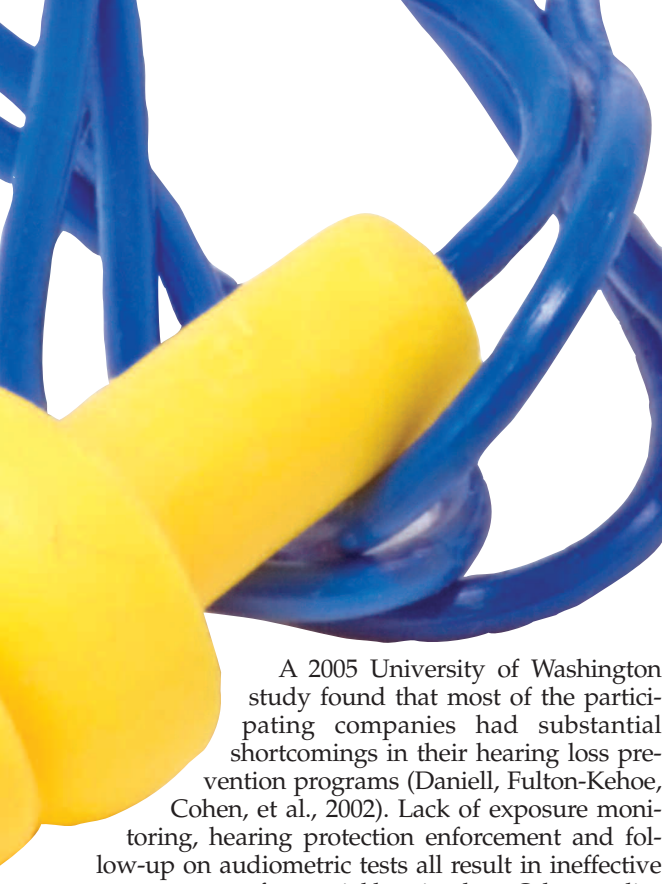


A 2005 University of Washington study found that most of the participating companies had substantial shortcomings in their hearing loss prevention programs (Daniell, Fulton-Kehoe, Cohen, et al., 2002). Lack of exposure monitoring, hearing protection enforcement and follow-up on audiometric tests all result in ineffective management of potential hearing loss. Other studies have shown that hearing loss can directly affect household income. Estimates suggest that the financial impact of unaddressed hearing loss in the U.S. exceeds $100 billion annually (Kochkin, 2007).

Hearing Loss Trends

Depending on the definition of exposure and impairment, NIOSH estimates that 5 to 30 million workers in the U.S. are exposed to noise levels at work which put them at risk of hearing loss. Noise is a common industrial safety hazard and noise assessments are a frequent focus of industrial hygiene consultations. Most noisy workplaces are familiar with OSHA's general industry noise standard (29 CFR 1910.95), but many are not in full compliance, which negatively affects employee potential hearing loss. Requirements for permissible noise exposures and controls under the construction standard, 1926.52 and 1926.101, are the same as those in the general industry standard (OSHA, "Noise and Hearing Conservation").

Hearing loss is the second highest specific reported occupational illness (Hager, 2009b). Interestingly, the incidence of hearing loss recordable cases is decreasing while some companies report seeing workers' compensation claims for hearing loss for the first time. This is due to a change in OSHA's hearing loss recordkeeping criteria, which has prompted earlier identification of hearing loss trends.

Beginning Jan. 1, 2003, employers were required to record workers with an average hearing loss of 10 decibels (dB) at 2000, 3000 and 4000 Hz, and whose hearing level threshold after the change averaged 25 dB or more at 2000, 3000 and 4000 Hz on the OSHA 300 hearing loss column. Such a loss is called a standard threshold shift (STS). Before 2003, hearing loss was recorded when an average loss of 25 dB was noted at 2000, 3000 and 4000 Hz. Under OSHA's standard, with recognized hearing loss, the employer must take additional protective measures, including use of hearing protective devices (HPD) for affected employees, HPD refitting and training, and a clinical audiological evaluation or an otological examination, as deemed appropriate.

Table 1

Common Noise Levels

Activity	Sound level (dB)
Whisper	30
Conversation	50 to 60
Printing press	90 to 95
Spray painting	85 to 105
Punch presses	100 to 105
Woodworking	100 to 110
Jet engine	140

Note. *Adapted from "Noise Meter," by NIOSH, 2009.*

Bureau of Labor Statistics (BLS, 2004-07) data reflect reduction trends following the implementation of the more rigorous OSHA reporting requirements. As Table 2 shows, recordable cases dropped 19% within the private industry sector from 2004 to 2007.

As a common industrial exposure, noise is frequently part of an OSHA inspection. Table 3 shows the significant number of OSHA citations for noncompliance with 1910.95 each year. This standard is the 12th most frequently cited OSHA standard for the manufacturing sector, according to OSHA. For example, one company was fined $89,750 for failure to protect workers against occupational noise hazards ($63,000 for failure to provide required medical evaluations; $24,750 for failure to maintain and monitor a hearing conservation program; and $2,000 for failure to meet recordkeeping requirements) (Smith, 2002). Although these penalties can be significant for an individual company, they pale in comparison to the cost of work-related hearing loss illnesses.

A 2004 study estimated that half of the 76 million baby boomers (born between 1945 and 1964) in the U.S. are experiencing some degree of hearing loss (Trads & Glasscock, 2006). The magnitude of this hearing loss is more than 2.5 times that of previous estimates. The increased rate of generational hearing

Despite reduction trends that emerged in the wake of more rigorous reporting requirements (Table 2), OSHA's occupational noise exposure standard remains one of the most frequently cited standards (Table 3).

Table 2

BLS Hearing Loss Data, Recordable Cases

Category/year	2004	2005	2006	2007
Total private industry	28,400	26,900	24,400	23,000
Goods, producing	24,300	22,900	20,000	19,400
Services	4,100	4,100	3,600	3,700

Table 3

OSHA Noise-Related Citations

Industry	OSHA standard	No. of inspections	No. of citations	Penalty
Manufacturing	1910.95	381	794	$578,188
Construction	1926.52	18	25	$21,500

Note. *OSHA noise-related citations, October 2007 to September 2008. Data from "Frequently Cited Standards," by OSHA, Washington, DC: Department of Labor, Author.*

Table 4

Noise Exposure Standards & Doubling Rates

Organization	Exposure limit Action limit	Decibel doubling rate dB(A)
OSHA	90 dB(A) 85 dB(A)	5
ACGIH	85 dB(A)	3
NIOSH	85 dB(A)	3
U.K. HSE	85 dB(A) 80 dB(A)	3

A 3 dB doubling rate indicates that each noise level doubling results in a 3 dB increase and is more conservative than a 5 dB doubling rate.

loss was attributed to workplace and recreational factors and, to a lesser degree, to aging and medical conditions (Trads & Glasscock, 2006).

Previous employment and aging also may affect hearing. The Institute of Medicine released a study in 2005 highlighting hearing loss among war veterans. Vietnam veterans are 40% more likely to have sustained high-frequency hearing loss than other veterans (Humes, Joellenbeck & Durch, 2005). Veterans, particularly those with tactical and artillery experience, may come into the workplace with preexisting hearing loss. Gun sports, motorcycles, power tools, lawn mowers and racing have been associated with the potential for hearing loss as has the use of personal music electronics (NIOSH, 2009; McCombe, 2003). Hearing loss can accelerate from the cumulative exposure to all of these sources.

Hearing Loss & Compensability

Workers' compensation statistics likely underestimate the magnitude of workplace-induced hearing loss (NIOSH, 2001). Lower STS criteria may result in earlier filing of workers' compensation claims, but workers' compensation hearing ability thresholds are unaffected by OSHA's regulatory changes. An STS does not automatically document the basis for a workers' compensation claim.

In the U.S., individual states have different hearing loss thresholds for workers' compensation partial and total disability, as well as various positions on workplace causation or aggravation of preexisting conditions. Each state has developed compensability laws and requirements. Presbycusis, the term for hearing loss due to aging, is taken into account by most states, but it is excluded in at least 13 states. Some states require documentation that workplace noise levels exceed 90 dBA (U.S. Chamber of Commerce, 2008). This emphasizes the need to carefully conduct and document noise assessments since past survey data may be requested as part of a compensability evaluation.

Workers' compensation benefits can vary dramatically. For total loss of hearing in one ear, benefits levels can range from $5,520 in California to $101,502 in Oregon above wage replacement. For cases involving total loss of hearing in both ears, the benefit levels range from $35,860 in Alabama to $250,985 in Illinois (U.S. Chamber of Commerce, 2008).

The definitions of *total hearing loss* or *occupational deafness* and the degrees of hearing loss also can vary as differing criteria are applied at the state level. These aspects directly affect the threshold at which work-related hearing loss is determined to be compensable. In the U.S., American Medical Association or American Academy of Otolaryngology compensation criteria is utilized. OSHA requires that work-relatedness be determined by a physician or other licensed health professional. Hearing loss determination is based on medical history, physical exam, audiogram and noise measurement data to determine whether hearing loss exists and to identify any workplace causation. Usually, a percentage of hearing loss is established that translates to a percentage of compensability (U.S. Chamber of Commerce, 2008).

Case submissions can be affected by factors beyond noisy jobs. These factors include a change in filing requirements, plant closings or layoffs, or military duty. A notable two-fold increase in the number of workers' compensation hearing loss claims in Washington state occurred between 1984 and 1998 due to a 2-year window restriction on the filing of hearing loss claims post initial diagnosis (Daniell, et al., 2002). Many of these claims were from workers older than 65. Military veterans also often file claims for hearing loss. Seventy-three thousand new cases were added to government rolls in 2003. In 2004, payments to veterans for hearing loss and tinnitus totaled $850 million (Humes, et al., 2005).

There has not been a high incidence of fraudulent hearing loss claims. Fraud is suspected when inconsistent audiogram responses are recorded or when sudden hearing loss is reported after prior normal audiograms with no specific linking event. Conversational abilities better than predicted by audiometric testing are another potential fraud indicator. Traditionally work-induced hearing loss audiograms show a detriment within the higher frequency range (2000 to 8000 Hz), with a "dip" at 4000 Hz (Nordstrom). As noted, a physician's determination of a work-related hearing loss case is based on substantiated noise exposure and measurement data, consistent audiometric and physical findings, and prior audiogram results. Equivocal or absent documentation may invalidate the finding of a work-related claim (Nordstrom).

Noise Exposure Limits

In the U.S., initial noise monitoring efforts are conducted to identify employees exposed to noise levels that exceed an 8-hour shift OSHA action level of 85 dBA for hearing conservation program inclusion. Average noise level measurement for shift exposures above the OSHA permissible exposure limit (PEL) of 90 dBA determine enforcement actions for appropriate hearing protection attenuation and engineering control efforts. The action level for 10- and 12-hour shifts are reduced to 83 dBA and 82 dBA, respectively, based on Table G-16A of 1910.95. OSHA's current policy is not to reduce PELs for extended shifts.

OSHA specifies that employee exposure to impulsive or impact noise not exceed 140 dBA. American Conference of Governmental Industrial Hygienists (ACGIH) noise threshold limit values, NIOSH recommended exposure limits and many

Table 5

NIOSH Hearing Impairment Research Estimates

40-year working lifespan	Exposed population %
Exposures up to 90 dB(A)	25%
Exposures up to 85 dB(A)	8%
Exposures up to 80 dB(A)	1%

Note. *NIOSH hearing impairment research estimates (1-2-3-4 kHz). Data from* Criteria for a Recommended Standard: Occupational Noise Exposure, *by NIOSH, 1998, Washington, DC: U.S. Department of Health & Human Services, CDC, Author.*

Table 6

Allowable Time Interval Noise Exposure Levels

	U. S. OSHA	ACGIH/NIOSH/HSE
8 hours	90 dB(A)	85 dB(A)
4 hours	95 dB(A)	88 dB(A)
2 hours	100 dB(A)	91 dB(A
1 hour	105 dB(A)	94 dB(A)

European standards are more conservative than OSHA's standard, with an 85 dBA 8-hour exposure limit and 3 dB doubling rate. Table 4 compares exposure limits and 3 or 5 dB doubling rates. A 3 dB doubling rate indicates that each noise level doubling results in a 3 dB increase and is more conservative than a 5 dB doubling rate.

OSHA adopted the 85 dBA action level due to concerns for potential hearing loss between 85 and 90 dBA (Table 5). NIOSH research estimates that the noise-exposed population at risk of hearing impairment at exposure levels up to 90 dBA is three times greater than those exposed up to 85 dBA. Table 6 shows that OSHA's standard allows two to four times greater noise exposure than NIOSH and ACGIH limits, which is an appreciable difference (ACGIH, 2009; NIOSH, 1998; Health and Safety Executive, 2005).

Noise Monitoring

An employer must implement a workplace noise monitoring program when information indicates that an employee's exposure to noise may exceed a time-weighted work shift average of 85 dBA (the OSHA action level). Having to "speak up" to be heard in normal conversation is a common noise overexposure assessment rule of thumb, according to OSHA's noise eTool. Typically, the first step is a noise exposure estimation via a preliminary assessment. This entails taking a series of measurements in noisy areas to validate prioritization for further monitoring.

Noise Surveys

Noise levels may be marked on a floor plan to identify noisy areas and boundaries, as well as to select employees for full-shift monitoring. Noisy areas where employees' exposures may exceed a time-weighted average of 85 dBA can then be targeted for more extensive noise monitoring.

A noise survey aims to determine:

- employees' work shift noise exposure;
- hearing conservation and hearing protection enforcement areas;
- necessary hearing protection attenuation;
- noisy equipment and areas, and engineering control options.

Where & When to Monitor

Representative worker noise monitoring should be completed to accurately assess exposures above and below the OSHA action level and PEL of 90 dBA. Employees who are overexposed to noise and not identified during monitoring surveys may suffer hearing loss.

Some companies conservatively choose to include employees who work just outside noisy areas in hearing conservation programs, while others seek to eliminate any unnecessary expense and oversight. In either case, noise monitoring is needed to identify and demarcate noisy areas for compliance enforcement, including the selection of hearing protection with the correct attenuation. Noise levels may change due to plant expansion or new equipment. OSHA requires that noise monitoring be repeated whenever a change that may increase employee noise exposure occurs on production, processes or controls.

Noise monitoring must include all continuous, intermittent and impulsive noise within an 80 to 130 dB range and it must be performed on a typical work day. Area or personal monitoring may be performed, with personal monitoring being best for variable noise exposure.

Monitoring Equipment

Typical noise monitoring equipment includes sound level meters, noise integrating dosimeters, impact noise monitors and octave band analyzers. OSHA specifies that sound level meters and noise dosimeters use a 5 dB exchange rate and minimally meet ANSI Type 2 standards (general purpose use) with an accuracy of ±2 dB. OSHA requires use of the A slow scale setting for sound level meter measurements. Type 1 meters have greater accuracy and are preferred for noise control work.

Noise exposures are typically measured with either a sound level meter or a noise dosimeter. The sound level meter measures instantaneous noise intensity. Such a device is often selected for measurements of continuous noise with little variation, such as printing presses or for preassessment work. Sound level meter measurements must be taken at different task locations and times in order to track the full range of potential employee noise exposures.

Variable noise is best monitored by noise dosimeters, which automatically integrate and store measurements as a time-weighted average result. Noise dosimeters offer various exposure display results including peak and dose, and the instruction manual should be carefully reviewed for results of interest. Variable noise exposures arise from tasks involving equipment with fluctuating noise levels or a job that requires frequent task or location changes. Noise dosimeters have a sound level meter function in addition to datalogging features.

Impulse or impact noise response meters or filters are designed for peak and integrated impulse measurements. Octave band analyzers are used to take frequency band noise level measurements to determine the appropriate type of noise control material or application (OSHA, 1910.95, Appendix III: A).

OSHA has an 85 dBA action level. However, NIOSH research estimates that the noise-exposed population at risk of hearing impairment at exposure levels up to 90 dBA is three times greater than those exposed up to 85 dBA (Table 5) As Table 6 indicates, OSHA's standard allows two to four times greater noise exposure than NIOSH and ACGIH limits, which is an appreciable difference.

It is well worth taking time in advance of noise surveys to become familiar with monitoring equipment and features. Instruction manuals should be reviewed (if missing, check manufacturers' websites). An entire survey day can be wasted by human errors such as failure to depress the dosimeter run mode button. Equipment batteries should be checked regularly as well. Avoid storing the devices in extreme temperature conditions, such as an automobile trunk, as this can affect battery life.

In addition, noise dosimeter microphones must be properly positioned in the hearing zone; they are typically clipped to workers' shirt collars. Manufacturers' instructions for sound level meter microphone positioning should be followed as well. Perpendicular incidence microphones should be pointed at the noise source (Cheremisinoff, 1996). Sound level tests are usually taken in close proximity to workers' ears and head to measure actual exposure. Different brands and models offer various operational mode selections and display features and settings should be reviewed for compliance with survey goals. Floor plans and recordkeeping sheets should be organized and prepared in advance during equipment setup as well.

Calibration is a critical quality control procedure. It involves checking instrument measurement against a known noise source emitted by the calibrator unit. Noise monitoring equipment should be calibrated before and after each usage with appropriate documentation completed and maintained. Calibration errors can occur if the calibrator is not turned on or if the microphone/calibrator interface is not tight. Such errors most frequently cause dosimeters to report readings in excess of actual levels. All noise measurement and calibration equipment should be calibrated to National Institute of Standards and Technology standards annually or at manufacturer recommended intervals (NIOSH, 1998).

If employees are to be fitted with noise dosimeters, hold a short explanatory meeting with a Q&A session the day before or morning of the noise survey. Common employee misconceptions include fears that conversations are being recorded or that placing the dosimeter next to a loud radio for a few moments will skew results. Normal activities should be encouraged. Since equipment should not be worn off premises, arrangements should be made to remove and refit equipment based on employee lunch plans.

Belt-worn dosimeters have a 3-ft cable that attaches to the microphone. This cable must be secured so that it will not become entangled while the employee is working. Tangled cable can detach from the dosimeter and present safety hazards. New cableless designs clip directly to the shirt collar to avoid these problems.

Employees should be given the consultant's name and cell phone number and be instructed to call should a need to leave work early arises or if equipment problems occur. Under OSHA's standard, employees must be allowed to observe monitoring activities and receive results.

Noise dosimeters should be placed in secure mode during testing to prevent tampering. They should be checked frequently to verify operating condition and correct placement during the testing period. Because it is possible that an employee will remove a unit or that the microphone element will come unplugged or sustain damage, the consultant must remain on site for the duration of the test to oversee equipment and maintain chain of custody. Chain of custody should be carefully documented as well since this issue regularly surfaces as an area of questioning in legal depositions.

The final noise report is the product of a complex consultation involving the preassessment, noise survey and hearing conservation compliance. The report should include the following elements:

- executive summary;
- table of contents;
- introduction and visit purpose;
- plant contacts;
- methods and equipment model and serial numbers;
- calibration information and chain of custody;
- areas and tasks monitored;
- result data tables with comparison to allowable limits;
- individual employee result for employee file;
- discussion of findings;
- OSHA 1910.95 compliance audit;
- recommendations;
- photos;
- floor layout plan marked with locations and results monitored.

The report must be specific regarding survey goals and objectives and methods used to accomplish them. Details supporting assessment accuracy must be provided, including equipment serial numbers, calibration documentation and chain of custody. Monitored tasks, measurement representativeness and periods monitored must be clearly identified. Any equipment problems should be discussed as well. Results should incorporate an audit against the provisions of OSHA 1910.95 with recommendations generated for any gaps noted.

Audiometric Testing & Intervention

A baseline and annual audiometric test program must be established for employees exposed to noise exceeding the OSHA action level within the first 6 months of employment or within the first year if a mobile van testing service is used. Baseline and annual hearing tests are then compared to detect early signs of hearing loss and enact appropriate follow-up action. These tests must be conducted by qualified professionals using calibrated test equipment as specified by OSHA 1910.95. Qualified professionals include licensed or certified audiologists, otolaryngologists, physicians and Council of Accreditation in Occupational Hearing Conservation (CAOHC) certified technicians under appropriate supervision.

Baseline audiograms should be accomplished in a timely manner. Continuous efforts must be made to administer the audiometric test program so that

employees with hearing loss do not "slip between the cracks" or that new employees with preexisting hearing loss are identified early on. Employees may be sent to an offsite audiology clinic or an audiology booth/van can be brought to the worksite for audiometric testing. Audiometric test rooms must meet OSHA 1910.95 Appendix D requirements.

OSHA 1910.95(g)(5)(iii) and (iv) mandate that employees' audiometric testing must be preceded by 14 hours of either no exposure to workplace noise or working while wearing hearing protection. In addition, employers must instruct employees to avoid high levels of nonoccupational noise exposure for the same 14-hour period. These practices will reduce the likelihood of a TTS being identified as hearing loss.

Audiology professionals prepare a report of each employee's results and identify problem audiograms. Experience shows that the quality and completeness of these reports vary widely so they should be carefully reviewed (Nordstrom). The employer should understand test results, implications and next steps after reviewing the reports.

All employees with an STS in hearing need to be identified and their cases followed. Employees must be informed of an STS within 21 days. Employees with STS may be retested by the employer within 30 days because OSHA will not allow the retest to stand in place of the initial exam if it is completed after 30 days. Typically, the employee also is medically evaluated for other ear problems that may obstruct hearing, refitted with hearing protection and retrained in hearing conservation. These interventions may cause the hearing loss determination to be reversed or help prevent further hearing loss.

Training

OSHA requires that all employees exposed to noise above 85 dBA receive annual training as part of a hearing conservation program. According to OSHA, this training must address the effects of noise on hearing, hearing loss prevention, hearing protection types and fitting, and audiometric testing purpose and procedures.

Hearing protection fit and enforcement are often overlooked aspects and sufficient time should be spent with each employee to make sure s/he understands proper fitting techniques. In addition, training should cover recreational noise and sources, as well as the retail availability of hearing protection devices for exposures outside of work.

Employees are more likely to use hearing protection properly and consistently if they perform training exercises with instructor feedback. Hearing protection must be worn 100% of the time in order to be effective. Resistance to HPD use, such as claims of discomfort or communication issues, must be addressed (NHCA/OSHA, 2008).

Noise Control & Hearing Protection

As noted, OSHA requires that employers first investigate engineering and administrative controls to reduce employee overexposure to noise. Engineering controls range from simple enclosures to expensive equipment retrofits that require a high level of expertise. Common engineering controls include vibration control and isolation, sound absorption and insulation, enclosures and sound attenuators. Administrative controls, such as job rotation, can pose scheduling challenges.

Noise can be controlled at the source generating the noise, along the path between the source and the receiver, or through the use of hearing protection worn by the receiver. Noise control at the source surpasses path and receiver controls.

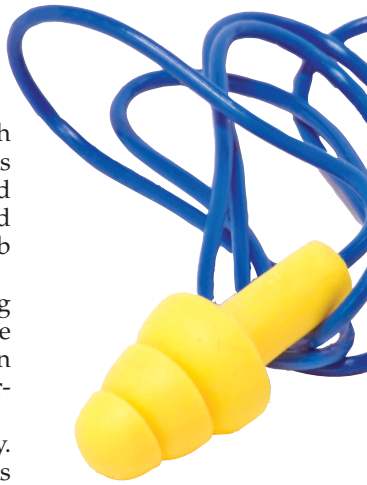
"Buying quiet" is an excellent noise control policy. Noise contribution and additional control options should be considered at purchase time. Retrofitting noise controls after purchase can be expensive and time consuming, and may deliver only partial success. "Buy quiet" programs begin with the purchaser supplying the vendor with a target noise level and noise testing requirements. Vendors must supply noise control plans and validation that the controls will be effective. Purchase payments may be subject to validated, agreed-on testing with a specified contract penalty for discrepancies (Wilson, 2009).

When engineering controls are infeasible or do not work, the employer must provide employees with HPDs. These devices are labeled with a noise reduction rating (NRR) that should be evaluated according to OSHA 1910.95, Appendix B. The NRR provides estimates, in decibels, of the reduction in noise exposure. Enforcement of hearing protection usage is required when an employee's 8-hour time weighted average exposure exceeds 90 dBA or when an employee with an STS is exposed above 85 dBA.

EPA is currently updating its NRR rule (40 CFR 211 Subpart B). The agency says the new rule will align with updated ANSI standards and that the new rule will consider the actual variability of HPD performance. Criticisms of the NRR rule include the original use of the C scale versus OSHA's A scale requirement and the lack of confidence in field HPD performance. Both factors resulted in OSHA inspectors derating the NRR by 7 dB, then afterwards by a 50% factor.

Application of new NRR rules is expected to eliminate derating, making HPD selection easier. The new rule will provide a potential NRR range, allowing for variability factors. However, the range option will likely create some confusion. Users will need to decide whether to adopt the conservative lower end of the range or develop confidence to select the higher end of the range.

New personal hearing protection testing technology has been developed that will help determine the actual degree of protection. These individual fit testing systems, much like respiratory protection fit test systems, provide a personal protection factor that incorporates individual variations. Such testing provides greater confidence in noise reduction level, providing individual customized feedback on fit adequacy. Ultimately, good fit and continuous usage enforcement are key to hearing conservation program success (Hager, 2009a).



Hearing protection fit and enforcement are often overlooked aspects and sufficient time should be spent with each worker to make sure s/he understands proper fitting techniques.

Some facilities have found success by demarcating HPD enforcement areas. Management and supervisors should demonstrate support for enforcement by wearing HPDs while within the area perimeter and enforcing employee HPD use. Enforcement should include identification and correction of policy violators.

Intervention Tools

Comprehensive hearing conservation program audit and intervention guidance are key to effective program management. NIOSH has developed a comprehensive program evaluation checklist that includes training and education, supervisor involvement, noise measurement, administrative and engineering controls, monitoring and audiometry, referrals, hearing protection devices and administrative matters. It can be found at http://www.cdc.gov/niosh/topics/noise/solutions/hearingchecklist.html. OSHA's noise eTool is found at http://www.osha.gov/dts/osta/otm/noise/index.html.

Conclusion

Noise and hearing loss have long been recognized as safety issues and compliance efforts often fall into a rut that impedes their success. Increasingly thorough intervention strategies are being recognized as a critical element of a complete hearing conservation program.

SH&E professionals engaged in the audit and management of hearing conservation programs will spur company recognition of hearing loss prevention goals and employee quality of life. The contribution of recreational noise, particularly with the advent of mobile music electronics, is also gaining awareness. Hearing loss prevention wellness programs work best when they are carefully managed with a "24/7 safety and wellness" worker perspective. ■

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