New Ideas in Construction Hearing Conservation

By DONALD J. GARVEY

Hearing loss and hearing conservation are major concerns of both construction management and the workforce. In a recent study, 65 percent of operating engineers, 44 percent of carpenters and 48 percent of plumbers reported a perceived hearing loss (Lusk, Kerr and Kauffman 468).

OSHA currently has two regulations—29 CFR 1926.52 and 101—that cover noise exposure in construction; these standards set a permissible exposure limit (PEL) of 90 dBA. They also require a hearing conservation program (HCP) and the use of hearing protection whenever noise levels cannot be reduced below PEL.

Why does hearing conservation continue to be such a problem in construction? This article reviews three innovative ideas that safety professionals can use to improve hearing conservation programs:

1) **Employee Exposure Assessment Methodology:** How can exposure in the field be better measured?

2) **Selection of Hearing Protection Devices:** Will better selection increase proper usage?

3) **Training for Workers:** What steps can be taken to improve hearing conservation training?

In addition, the growing problem of off-work noise exposure and the significant risk it poses to construction workers and contractors is discussed. It should be noted that PELs and noise exchange rates are not discussed; these areas are both complex and controversial. In the author's opinion, increased attention to the cited areas has the greatest potential to produce significant gains in hearing conservation; simply lowering PEL without giving due attention to these areas will not increase employee protection.

EXPOSURE ASSESSMENT METHODOLOGY

A major problem in construction is the variability of noise exposure during the course of a project. Exposures are rarely the same on any two days. Consequently, basing noise assessments solely on the traditional dosimeter-derived eight-hour time weighted average (TWA) creates several problems.

1) How many samples (of the workforce or an individual) are sufficient to make statistically valid decisions regarding worker risk?

2) Reduction of which noise sources will have the greatest impact on overall exposure?

3) How meaningful are the results to workers and management—can these measurements be used to help teach and train workers?

One potential way to overcome these problems is through use of the Task-Based Exposure Assessment Model (T-BEAM). This method is currently used in general industry and its applicability to construction is being investigated (Franks 54; NIOSH 70; Hager 417). T-BEAM uses work tasks as the central organizing principle for collecting exposure data:

1) Occupation of interest is identified and workers are separated into job category or function.

2) Hazardous agent of interest (e.g., noise) is identified.

3) Detailed list of specific tasks associated with the function is developed.

4) Each task is reviewed for the hazard (e.g., sound level meter readings, worker/management interviews). Emphasis is placed on long-term activity, not what transpires on a particular day. Actual noise measurement is performed using an integrating sound level meter; sample duration ranges from several minutes to one hour, depending on the task and technician expertise. A task is usually measured several times to arrive at the final measurement. Each task is also reviewed for potential control interventions.

5) A list of each task, its noise level and possible durations is developed.

Modeling for any combination of tasks and durations can then be performed using the formula:

% dose = [C1/T1 + C2/T2 + Cn/Tn . . .] x 100%

Cn = duration (in hours) worker spends at a specific sound level

Tn = allowable duration (in hours) for that noise level (e.g., 29 CFR 1926.52 Table D-2)

% dose = percentage of max. daily allowable noise dose (e.g., 90 dBA 8-hour TWA = 100%)

T-BEAM allows modeling of exposure risk for "typical" and "worst-case" days and other scenarios by assembling sound level measurements and assumed exposure durations relative to any specified combination of tasks.

National Institute for Occupational Safety and Health (NIOSH) uses the example of a worker's intermittent use of a grinder to illustrate the use of T-BEAM. The tool produces a 100 dBA noise level; per OSHA regulations, two hours total exposure puts the worker at PEL.

Assuming the worker uses the grinder for more than two hours on the day that an eight-hour TWA dosimetry test is conducted, s/he would be identified for inclusion in an HCP.

However, if this employee performed only one hour of grinder work on the day of the test (50 percent of allowable dose), the conclusion may not be the same, and s/he may be excluded.

By focusing on tasks and discussions with the worker (which would reveal that s/he *could* use the tool two or more hours per day), the employee would be identified as potentially at risk for overexposure (Franks 54).

Task-based assessments:

- Rank workers for further assessment and hearing conservation measures.
- Overcome the often-cited "no typical day" problem.
- Allow a variety of workdays and activity levels to be modeled in order to make risk assessment decisions.
- Enable control measures (engineering or administrative) to better target the greatest source(s) of noise exposure.
- Provide more meaningful information to workers. These assessments show duration of allowable exposure (rather than decibels and discussions of exchange rates) to illustrate how tasks combine to result in overall risk.
- Provide data on durations of allowable exposures, which can be used in training to emphasize the need to wear hearing protection at all times.
- Involve employees by seeking their input via interviews and observations performed during data collection (Franks 55; Hager 1999).

Although one can cite several disadvantages, these can usually be managed. For example:

- The person collecting data must be near the worker. On a construction site, this could be a safety hazard. This problem could be overcome with dosimeters and willing workers/management.
- All noise exposure sources must be accounted for—missing a major source could be a crucial mistake. Non-cyclical jobs present the greatest challenge and require increased employee/employer involvement.
- Each task must be appropriately time-weighted to ensure that long-term estimates are accurate and reasonable.
- The data collector must have appropriate training and experience since judgment of task duration and development of profiles in highly variable work environments can affect data.
- Non-routine work must also be identified and monitored.

Although it may not be possible to predict an individual's actual exposure, one should be able to at least categorize a worker as "no," "some" or "substantial" risk of hazardous exposure (Stephenson). Although this system is not perfect, it is a major improvement over current methods.

SELECTION OF HEARING PROTECTION DEVICES

Selection of the proper HPDs is crucial. Overprotection can needlessly impair a worker's speech communications ability—a factor often cited by workers as a key reason they do not wear the devices. Conversely, underprotection can allow excessive exposure to noise, which increases the risk of hearing loss.

Making the proper determination is challenging, however. Currently, three recognized ways are available to evaluate the appropriateness of HPDs with regard to noise reduction.

Hearing protector manufacturers publish noise reduction ratings (NRR) for their products. The NRR indicates—under laboratory conditions—what the expected noise reduction is for a specific HPD. 29 CFR 1926.52 and 101 simply require that hearing protectors reduce noise levels received by the ear to less than 90 dBA. 29 CFR 1910.95 is more detailed and requires that the following formula be used:

(TWA exposure in dBA) - (NRR - 7) < 90 dBA
(Formula 1)

However, experience has shown that many workers fail to achieve the manufacturer's published NRR level in the field. To account for this, OSHA recommends this formula:

(TWA exposure in dBA) - [(NRR - 7)/2] < 90 dBA
(Formula 2)

The 50-percent reduction is a safety factor designed to account for the reduced reduction experienced in the field.

For the same reason, in its recent Criteria Document, NIOSH recommends de-rating the published NRR before using Formula 1 (NIOSH 5). NIOSH specifies de-rating based on HPD types: 1) muffs = 25 percent reduction; 2) formable plugs = 50 percent reduction; 3) others = 70 percent reduction.

For example, for a foam plug (29 NRR), the "delivered" noise reduction according to the Criteria Document should be assumed to be:

de-rated NRR = 29/2 = 14.5
Per Formula 1: 14.5 - 7 = 7.5 delivered reduction

Thus, via these three methods, the "delivered" NRR for a foam plug (29 NRR) ranges from 22 dB to 11 dB to 7.5 dB. This raises the question, "Which method should be used?"

A fourth method is now available—ANSI S12.6-1997, "Subject Fit Method." This method may provide the best estimate of real-world performance of HPD. The primary differences between the ANSI methodology and the current NRR methods are:

1) Evaluations are performed by a third-party laboratory, not a manufacturer.

2) Test subjects are untrained; they receive only the instructions printed on the package.

The resulting reduction is referred to as NRR(SF) to distinguish it from current NRR. According to the S12.6-1997, 84 percent of users can expect to achieve at least the reduction noted on the NRR(SF) and many will achieve a higher level. One cannot, however, determine the reduction achieved by a specific individual.

In addition, the NRR(SF) can be subtracted directly from the noise exposure data to estimate worker exposure—no need to subtract 7 or divide by 2. In its comparison of the two ratings, NIOSH published the following results:

E-A-R foam NRR = 29; NRR(SF) = 13.2
Ultrafit premold NRR = 21; NRR(SF) = 7.3
Bilsom UF-1 muff NRR = 25; NRR (SF) = 16.3 (65).

It should be noted that NRR(SF) tends to be significantly higher than NRR derived from either the OSHA or NIOSH method. This may allow for a wider range of HPD selection options, which in turn may increase worker acceptance and use.

EMPLOYEE TRAINING

Some construction workers readily wear hearing protection, others expend great effort to avoid it. Using Pender's previous research, Lusk, Ronis and Hogan developed the "Predictors for Use of Hearing Protection Model" (184). These five cognitive/perceptual factors appear to account for more than 50 percent of the variability between groups of construction workers who wore HPD and those who did not. The five factors:

- **Control of health:** the extent of a person's perception of his/her ability to maintain personal health.

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• **Self-efficacy:** confidence in one's ability to use HPD.

• **Benefits:** expected positive effects of HPD use.

• **Barriers:** potential negative aspects of this behavior.

• **Value of use:** perceived importance of the outcome of using HPD.

Each factor was measured using previously developed scales such as a Likert-type scale (e.g., strongly disagree to strongly agree).

Demographics (age, workplace noise exposure), interpersonal influences (social norms, role models) and situational factors (availability of HPD, organizational support for employee health) also contribute to use/non-use. However, many of these factors cannot be altered by the individual worker. Therefore, intervention based primarily on the cognitive/perceptual factors appear to have the greatest potential to produce change.

Consideration of these factors can lead to improved HCP training—which may lead to increased use of HPD among workers. For example, site management can:

• Segment the training audience into more homogeneous groups and develop group-specific objectives.

• Determine what type of message is likely to work best with each group.

• Identify how each group perceives the health threat and determine how each group feels about its ability to reduce and/or control that threat.

• Identify the current attitudes and behaviors about the threat—are group members defensively avoiding or reacting against the hazard?

• Determine what information source is most trusted by the group as well as what mode of communication the group prefers—audio, video, written, verbal, non-verbal.

SOCIETY'S VIEW OF NOISE

The final issue that contractors must be aware of—and one that may hamper even the best HCP—is society's view of noise (non-occupational exposure). Today, the message is "Loud is better." Stereo manufacturers encourage young people to "play it loud," which implies an element of rebellion or danger. Crowds at sporting events are encouraged to "Make some noise!" The message is that loud is good, not something to avoid.

Most safety professionals recognize that off-the-job noise exposure can be a problem. Yet, such exposures continue to increase and can occur in surprising places. For example, during the action sequences of movies such as *Armageddon* and *Godzilla,* the noise level ranges between 96 and 110 dBA, while non-action sequences range between 80 and 85 dBA. According to an Aug. 5, 1998 article in *USA Today,* "Jerry Bruckheimer [producer of *Armageddon*] likes his movies as loud as he can make them. That's realism, he says." Many movie-goers agree. "Movies nowadays are experiences, loud sound is part of the experience" (Seiler 8).

Construction workers' off-hours hobbies may include noise-producing activities such as riding a jet ski (115 dBA) or snowmobile (110 dBA). (Ironically, a jackhammer may "only" produce around 105 dBA and a chainsaw around 100 dBA.) Consequently, they may suffer from off-the-job exposure that worsens—or is worse than—on-the-job exposure.

As a result, an employer may end up carrying the liability for a workers' compensation hearing loss claim regardless of whether that loss was totally or partially due to non-work-related exposure. The current audiometric testing programs cannot distinguish between the two.

CONCLUSION

To prevent hearing loss among construction workers, contractors need to pursue some new ideas:

1) Develop better noise exposure assessment tools such as T-BEAM, which can overcome inherent difficulties encountered when monitoring construction workers.

2) Design better methods to assess and select HPD to prevent unnecessary over-protection and dangerous underprotection. The ANSI Subject Fit method is one possibility.

3) Customize training to better address the varying needs of a diverse workforce.

4) Recognize that "loud is in." Contractors must acknowledge that non-work-related exposure may defeat all on-site efforts to reduce exposure and realize that they may still be held liable for any hearing loss. ■

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