Calculating Hearing Protection Effectiveness

Reducing employee exposure to noise is most effectively accomplished through engineering controls. Engineering controls should be implemented as the preferred means to reduce the worker's noise exposure below 90 dBA for an eight-hour time weighted average (TWA). Although in certain situations the Occupational Safety and Health Administration (OSHA) does permit controlling noise through administrative controls and/or in combination with a hearing conservation program, these methods aren't as effective as well designed and maintained engineering controls.

When earplugs or earmuffs are used as a means of protection, you need to know if the protection reduces the employee's exposures below current requirements. While hearing protectors are assigned a noise reduction rating (NRR) rating by the Environmental Protection Agency (EPA), the NRR simply can't be subtracted from the level of noise to which an employee is exposed. In addition, the NRR value is determined in a laboratory; in the real world, employees don't generally receive as much noise protection.

To estimate the attenuation provided by hearing protectors and an employee's estimated amount of noise exposure (protected TWA), the following calculations can be used. Note: while OSHA doesn't require the 50 percent safety factor to be used for all regulatory purposes in the Occupational Noise Standard (1910.95), Argent feels OSHA's NRR adjustment process detailed below is best method for determining if the hearing protectors provided by employers to their employees provide adequate production from the damaging effects of noise.

For muffs or plugs:

- Determine the NRR. This number is typically visible and should be on the hearing protection packaging.
- Subtract seven decibels from the NRR to correct for using A-weighted measurements.
- OSHA compliance offices then take half of the corrected NRR from the noise exposure.

Example One
Measured Employee Exposure = 100 dBA eight-hour TWA
Muff NRR = 20 decibels
Solution: Attenuation is (20 -7)/2 = 6.5 decibels
Protected TWA: 100 dBA TWA - 6.5 decibels = 93.5 dBA

Conclusion: The protected TWA can be assumed to be 93.5 dBA. This hearing protection isn't adequate and engineering controls should be utilized. If engineering controls aren't feasible better hearing protection must be used. If the employee shows STS, administrative controls or medical removal should be employed.[1]

Example Two
Measured Employee Exposure = 98 dBA
eight-hour TWA **Plug NRR** = 29 decibels
Solution: Attenuation is (29 - 7)/2 = 11 decibels
Protected TWA: 98 dBA TWA -11 decibels = 87 dBA

Conclusion: The protected TWA can be assumed to be 87 dBA. This hearing protector is adequate if the employee doesn't exhibit STS or where there is less than six months from the employee's first exposure and their baseline audiogram using the mobile test van exception (1910.95(g) (5) (ii)). Engineering controls should be utilized to further reduce the noise level below 85 dBA.

For dual protection *(e.g., employee wears both muffs and plugs):*

- Determine the laboratory-based noise attenuation (NRR) for the higher rated hearing protector.
- Subtract seven decibels.
- Divide by two
- Add five decibels to the field-adjusted NRR to account for the use of the second hearing protector.

Example Three

Measured Employee Exposure = 110 dBA BA Employer requires dual protection.
Plug NRR = 29 decibels
Muff NRR = 25 decibels
Solution: (a) Calculate adjusted NRR for the better protector. (29 -7)/2 = 11 decibels
(b) For dual protection add five dB to this field-adjusted NRR. 11 + 5 = 16 DB
Protected TWA: 110 dBA TWA -16 decibels = 94 dBA

Conclusion: The protected eight-hour TWA is 94 dBA. This hearing protection isn't adequate and engineering controls should be utilized. If engineering controls aren't feasible better hearing protection must be used. If the employee shows STS, administrative controls or medical removal should be employed.