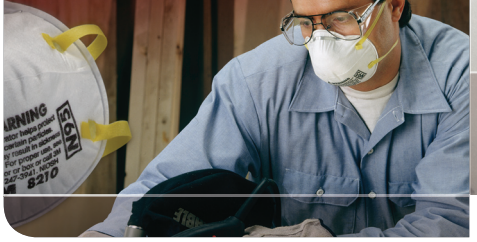

August 2007 Vol. 25. No. 5

JobHealth Highlights

Technical Information for Occupational Health and Safety Professionals

Lower OSHA Noise Exposure Limit Needed to Help Prevent Noise-Induced Hearing Loss

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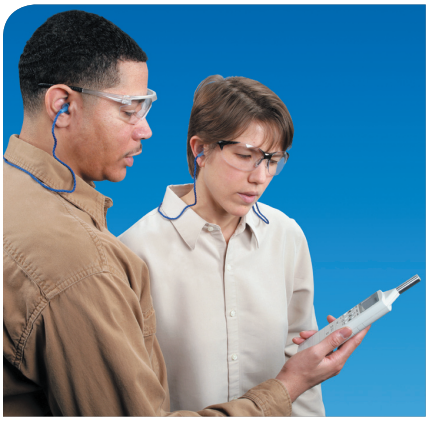

3M has added its voice to a growing number of organizations that are calling for the U.S. Occupational Safety and Health Administration (OSHA) to adopt lower limits for occupational noise exposure levels and exposure time in order to help reduce noise-induced hearing loss in the workplace. As a member of the Hearing Protector Group of the International Safety Equipment Association (ISEA), the 3M Occupational Health and Environmental Safety Division has joined with other hearing protector manufacturers in expressing support for an ISEA proposal to change OSHA regulation 29 CFR 1910.95. In a formal request delivered on January 26, ISEA petitioned OSHA Administrator Ed Foulke to lower the 8-hour Time Weighted Average (TWA) permissible exposure limit (PEL) for occupational noise from 90 dBA to 85 dBA and to adopt a 3 dB exchange rate for calculating noise dose as a function of exposure time and level.

The rationale for implementing these changes is clearly stated in a position paper written for ISEA by widely respected hearing conservation expert, Alice Suter, Ph.D., who authored much of the existing OSHA noise regulation more than 20 years ago.

In her paper, Dr. Suter describes the significant reduction in work-related noise-induced hearing loss that is likely to occur with a more protective PEL and noise dose calculation paradigm. The first half of that paper which describes the scientific evidence supporting the 85 dBA PEL is re-printed here with the permission of ISEA. The second half of the paper, a discussion of the basis for using a 3 dB exchange rate will be published in Job Health Highlights next month.

Position Paper on Regulation of Occupational Noise Exposure

Alice H. Suter, Ph.D.

Prepared for the Hearing Protection Group of the International Safety Equipment Association (ISEA)

December 8, 2006

Introduction

Nearly a quarter of a century has passed since the hearing conservation amendment of the U.S. Occupational Safety and Health Administration (OSHA) was first promulgated in 1981, then revised in 1983. While the amended regulation maintained the existing permissible exposure limit of 90 dBA, time-weighted average (TWA), the amendment called for hearing conservation programs at an action level of 85 dBA, TWA. Despite these many years of experience, it is clear that a great many American workers are still losing their hearing. There are several reasons why this is happening. In spite of the widespread use of hearing protection devices, many of today's hearing conservation programs are inadequate, with deficiencies in audiometric testing and training, as well as in other program areas, especially in small and mid-sized companies. Current OSHA policies offer little incentive to control noise by engineering means, which is usually the most effective method of preventing noise-induced hearing loss. The noise regulation is not being adequately enforced by State and Federal authorities, and many companies are providing ineffective hearing conservation programs or no programs at all.

There are two additional factors that bear on the ineffectiveness of OSHA's regulation and therefore on the unacceptable prevalence of noise-induced hearing loss. These are factors that most other industrialized nations have already addressed, and about which the U.S. is seriously in arrears. One is the need to unify the permissible exposure level (PEL) with the action level at 85 dBA, and the other is the need to abandon the 5-dBA exchange rate (ER) in favor of the 3-dBA rule. The history, rationale, and scientific support for each of these actions will be explained below.

Unify the PEL with the 85-dBA Action Level

Damage-Risk Criteria for Hearing Loss

Many factors enter into the development of criteria for the prevention of hearing loss, including policy as well as technical considerations. First there is the thorny question of what percentage of the exposed population should be protected. When the Department of Labor issued the first Federal noise standard, the selected 90-dBA PEL was thought to protect about 80% of the exposed population (Dept. Labor, 1970), leaving 20% of the population to incur a hearing impairment. Since that time, the National Institute for Occupational Safety and Health (NIOSH) has estimated that between 23% and 32% would incur a material impairment of hearing at the 90 dBA PEL, depending upon the definition of hearing impairment (NIOSH, 1998). The question of what constitutes an acceptable risk for hearing impairment has never been resolved, either by a Federal agency or a consensus organization concerned with noise issues. The tendency,

however, in both the U.S. and internationally, is to move toward a greater degree of protection.

Another factor that is central to the selection of the PEL is the definition of hearing impairment. Since 1969 OSHA has referred to "material impairment of hearing" as the amount of hearing loss that should be prevented. In the early days this was defined as an average hearing threshold level or "low fence" of 25 dB or greater at the audiometric frequencies of 500, 1000, and 2000 Hz. In recent years the definitions have become more conservative, with most groups advocating definitions that include frequencies above 2000 Hz because of their importance for the understanding of speech, especially when speech is degraded by various amounts of background noise (see Suter, 2003; NIOSH, 1998). For example, OSHA and the Mine Safety and Health Administration (MSHA) now use 25 dB at 1000, 2000, and 3000 Hz (OSHA, 1891; MSHA, 1999), and the most recent NIOSH criteria document (NIOSH, 1998) uses 1000, 2000, 3000, and 4000 Hz. In general, as definitions include higher frequencies and lower fences, the acceptable risk becomes more stringent and a higher percentage of the exposed population will be at risk from given levels of noise. There is widespread agreement that the old definition using merely 500, 1000, and 2000 Hz is now obsolete and that definitions using frequencies above 2000 Hz should be substituted for 500 Hz or at least added to the formula (AAO-HNS, 1979; NIOSH, 1998; Smoorenburg, 1986; King et al., 1992).

The choice of database for noise exposure also enters into the selection of the appropriate PEL. The major databases used in the promulgation of OSHA's noise regulation as well as the NIOSH criteria document are also featured in the leading consensus standards, both historically and currently. They are those developed by Burns and Robinson (1970), Passchier-Vermeer (1968; 1971), and NIOSH (1972). It is no longer possible to conduct large crossectional studies of noise exposure because the widespread and often mandatory use of hearing protection devices renders the noise exposure levels virtually unknowable, so reliance on the original studies is necessary. Although there are several methodological differences among these databases, there is general agreement about the levels of noise producing certain amounts of hearing loss. The data from Burns and Robinson plus those of Passchier-Vermeer have been incorporated into international standard ISO R1999.2 (ISO, 1990) and its American counterpart, ANSI S3.44 (ANSI, 1996).

The most recent NIOSH criteria document shows the percentage of "excess risk" (those expected to incur hearing impairment from noise exposure) over a working lifetime from average noise levels of 90, 85, and 80 dBA as a function of the definition of material impairment of hearing, as determined by various organizations (see Table 1 on page 4).

There is general agreement about the levels of noise producing certain amounts of hearing loss

Table 1. Percentage of the exposed population expected to incur hearing impairment after 40 years from three noise exposure levels as a function of definition of material impairment, as reported by various organizations (NIOSH, 1998).

Table I. Definition of Material Hearing Impairment

	Average Exposire Level (dBA)		
	90	85	80
0.5–1–2 kHz			
1971–ISO*	21	10	0
1972–NIOSH	29	15	3
1973–EPA*	22	12	5
1990–ISO	3	1	0
1997–NIOSH	23	10	4
1–2–3 kHz			
1972– NIOSH	29	16	3
1990–ISO	14	4	0
1997– NIOSH	32	14	5
1–2–3–4 kHz			
1990–ISO	17	6	1
1997– NIOSH	25	8	1

* The early ISO standard incorporated the data of W.S. Baughn, and the EPA included the Baughn data as well as those of Burns and Robinson and Passchier-Vermeer (Baughn, 1973; EPA, 1973). The Baughn data were later excluded by the ISO, and NIOSH relied exclusively on its own noise-exposure data to develop its earlier damage-risk criteria.

In addition to the choice of noise-exposed database, the choice of non-noise-exposed population also enters into the equation, because these hearing threshold levels are subtracted from those of the occupationally exposed group to determine the amount of damage due to noise. Here it is imperative that the two populations be matched. Both the NIOSH occupationally exposed and non-exposed populations were similarly screened to exclude exposure to firearms, ear disease, and unknown noise exposures (NIOSH, 1972). One could argue that a more contemporary population, such as the one described in ANSI S3.44 Annex C (Royster et al. 1979; 1980), should be used since non-occupational noise levels appear to have increased over recent decades (Axelsson, 1996). However, as neither the older Annex B nor the newer Annex C populations were screened, it would be inappropriate to use them as comparison populations with the more rigorously screened Burns/Robinson and Passchier-Vermeer noise exposed populations, the major databases used to formulate ISO R1999.2 (1990) and ANSI S3.44 (1996).

Over recent years the scientific and hearing conservation communities have paid increasing attention to the threat to hearing from non-occupational exposures, such as noisy leisure time activities, shooting, and even the noise from traveling in a car or bus. It would not be reasonable to set a PEL at an average level experienced

by those exposed non-occupationally. In recent studies of construction workers by Neitzel et al. (2004a; 2004b) the authors found that average exposures away from work tended to be below 80 dBA. They found that 79% of the construction workers measured showed average (calculated with the 3-dB exchange rate) off-work exposures below 70 dBA (Neitzel et al. 2004a). In a longitudinal study of construction apprentices, they found an average non-occupational exposure of 78 dBA (Neitzel et al. 2004b). These results are consistent with the mean 24-hour average exposure level of 78 dBA measured by Berger and Kieper (1994) on 20 subjects, most of whom were non-occupationally exposed. Neitzel and his colleagues did not include noise levels from firearms because of a lack of consensus on the method by which impulse noise should be included in the resulting measurement. They concluded that for shooters, who comprised 22% of the apprentices, the average non-occupational exposure level would be higher.

Selecting the PEL

On examining Table 1, it is clear that the risk of material impairment of hearing is considerable at an average exposure level of 90 dBA, substantially less at 85 dBA, and small-to-negligible at 80 dBA. Since there appears to be general consensus to allow some hearing impairment in a small portion of the exposed population, assuming that they will be so exposed for their entire working lifetime, most regulatory and standard-setting authorities have compromised on an average exposure level of 85 dBA (see Table 2 below). Also, because average non-occupational exposure levels can approach 80 dBA, or even exceed that level among workers who use firearms, it is reasonable to place the PEL at 85 dBA.

The risk of material impairment of hearing is considerable at an average exposure level of 90 dBA, substantially less at 85 dBA, and small-to-negligible at 80 dBA.

In addition to the NIOSH recommended exposure limit, other major organizations concerned with the prevention of noise-induced hearing loss have adopted an 85-dBA PEL. The American Conference of Government Industrial Hygienists (ACGIH) adopted a "threshold limit value" (TLV) of 85 dBA in 1976, and has continued to support it since that time (ACGIH, 2000).

The U.S. Department of Defense has used 85 dBA for many years, as have all three branches of the military service (DoD, 1996).

In Europe, the various nations must harmonize their standards and regulations with the "directives" issued by the Council of the European Communities. In 1986, the European Communities (EC) published directive 86/188 EEC, which directed member states to require employers to provide hearing protectors, information, and audiometric tests above 85 dBA, a noise control plan and mandatory use of hearing protectors above 90 dBA, and the duty to reduce noise to the lowest level "reasonably practicable" through noise control measures (EC, 1986). In 2003, the EC changed the PEL to 87 dBA, but required an "upper action" level of 85 dBA at which employers must implement a program of noise reduction, taking into account

technology and the availability of control measures (EC, 2003). At no time should employees' exposures exceed an average level of 87 dBA, although the attenuation of hearing protectors may be taken into consideration when estimating this level.

While the current European directive may seem confusing to Americans, it appears that the intent is to encourage the use of engineering controls to the relatively "safe" level of 85 dBA, but to allow hearing protectors to reduce exposures to a not-to-exceed level of 87 dBA while noise controls are being implemented and in cases where they are infeasible.

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