

Hearing assessment is an essential part of hearing conservation.

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Summary

In a survey conducted by the Australian Safety and Compensation Council (ASCC), across industries in Australia it was found that persons most exposed to loud noise, for longer periods, are employed in the mining industry. In addition, the Queensland Health Improvement and Awareness Committee (HIAC) have ranked noise as the number one health hazard in Queensland mining.

Due to the mechanical processes essential to production methods in mining and quarrying, noise exposure control is heavily reliant on the use hearing protectors including ear plugs and muffs. Training is also provided on how to prevent hearing damage. This includes the selection and fitting of hearing protection devices.

If the type of hearing protector does not reduce the noise to an acceptable level nor is it fitted correctly, noise induced hearing loss (NIHL) will occur. Permanent noise induced hearing loss is verified through audiometric testing where a permanent threshold shift is observed. As implied, once NIHL is detected the damage to hearing is permanent.

It is important that monitoring be carried out to evaluate the effectiveness of hearing conservation programs.

Permanent hearing loss is preventable. It is therefore important, that ongoing health surveillance incorporates a measure to detect early hearing loss.

Background

The Queensland Health Improvement and Awareness Committee (HIAC) is a tripartite committee. HIAC has been established to enable the Mines Inspectorate work in unison, with unions and industry, to provide a greater emphasis on worker health and the prevention of illness and disease. To prioritise health hazards, a broad brush health risk assessment has been completed. HIAC meet quarterly and the meeting minutes and assessment prioritisation table can be viewed by the public at:

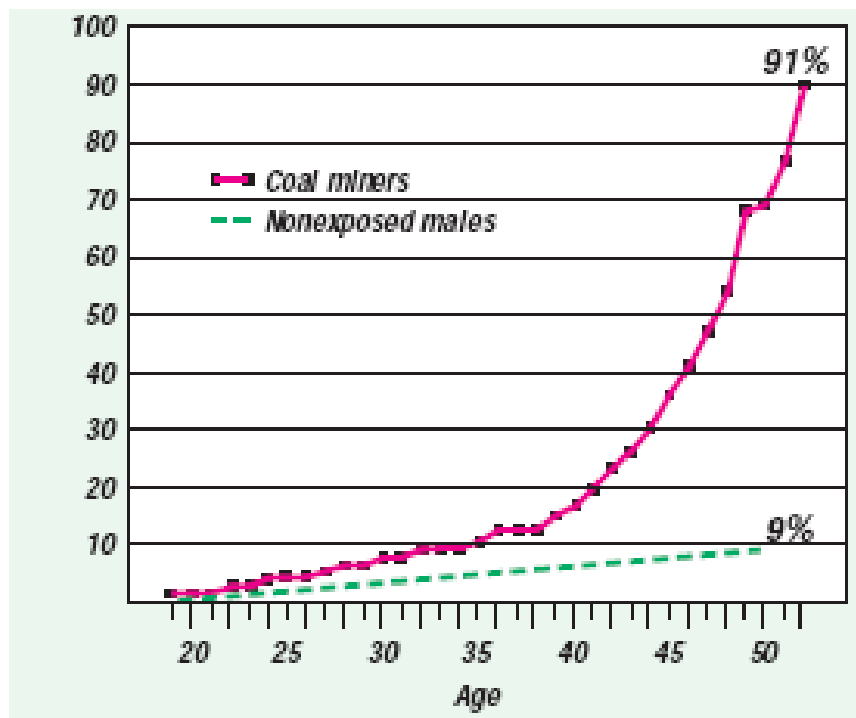
http://www.dme.qld.gov.au/mines/health_improvement_and_awareness_committee.cfm

The broad brush risk assessment carried out by HIAC has identified noise as the number one priority for Queensland Mining.

Because of the different ways in which hearing loss is defined, it is difficult to get a clear picture of the prevalence of NIHL in mine workers. A study of 2484 white South African gold miners defined social impairment as an average loss of > 25 dB for the audiometric frequencies 0.5, 1 and 2kHz. At age 58, 21.6% fell into this group, while reference to ISO 1999 shows only 5% of a non noise exposed group would be expected to have this level of disability.

Similarly a review of coal miners audiograms conducted by NIOSH in 1998 showed that at age 50 approximately 90% of coal miners have a hearing impairment. This is in contrast to only 10% of the non occupationally exposed male population (Matetic 2005).

Figure 1. Percent of males with hearing impairment: male coal miners vs. general population of non-noise exposed males.



Source: Merry and Stephenson 1998: Holmes Safety Association Bulletin, MSHA 1998 (October)

The most important component of audiometry in hearing conservation is the early detection of noise-induced hearing loss (McBride 2004) by way of a deterioration from “base line” hearing status, the so called “significant threshold shift” or “standard threshold shift” (STS) identified during serial audiometry.

A preventative approach is to prevent early hearing loss that occurs directly after noise exposure which is referred to as temporary threshold shift (TTS). This temporary threshold shift (TTS) is a predictor of permanent loss and is of the same order as the permanent loss expected after exposure to the same level of noise for 10 - 15 years (McBride 2004).

The current AS/NZS 1269 titled Occupational Noise Management consists of five parts: Overview, Measurement of Noise and Exposure, Noise Control Management, Hearing Protector Program and Auditory Assessment. However, it does not have force in law nor does it specify acceptable noise criteria. Statutory regulations have been promulgated for noise limits. Under the Queensland Mining and Quarrying Regulation (2001), the peak limit is 140 dB(C) and the 8-h equivalent continuous A-weighted sound pressure level limit is 85 dB(A). In many mines employees work continuous 12-hr shifts, this means that the limit is reduced due to longer durations of noise exposure and less recovery time between shifts.

This means that in these situations 85 dB(A) 8-hr is equivalent to 82 dB(A) where subsequent 12-hr shifts are worked. It is therefore important that where noise monitoring is carried out and comparison is made with the limit of 85 dB(A) 8-hr, the noise monitoring results are normalised and adjusted if the shift length is in excess of 10 hours. It also means that the risk of noise induced hearing loss (NIHL) is much greater for subsequent 12-hr shifts.

According to AS/NZS1269, management are required to conduct a noise survey, to implement controls and provide progressive audiometry. In mining there is a high level of reliance on hearing protection. It is therefore extremely important that routine audiometry be carried out to ascertain that the hearing protection program is effective.

In addition as there is a high reliance on controlling noise through hearing protectors it is important that the hearing protectors are effective. There are instruments on the market to test the effectiveness of hearing protection on a person.

Health Effects

Prolonged exposure to loud noise will cause hearing loss. Noise induced hearing loss is progressive and a permanent threshold shift is not reversible.

Noise affects hair cells in the inner ear and most hearing loss is bilateral. Symptoms may include gradual loss of hearing, hearing sensitivity and tinnitus. One of the first signs of hearing loss due to exposure is a "notching" of the audiogram at 3000, 4000, or 6000 Hz with recovery at 8000 Hz. The rate of hearing loss due to chronic noise exposure is greatest during the first 10 - 15 years of exposure. This is different to age-related loss (presbycusis) which accelerates over time. Most scientific evidence indicates that previously noise-exposed ears are not more sensitive to future exposure and that hearing loss due to noise does not progress in excess of what would be expected from the addition of age-related threshold shifts once the exposure to noise is discontinued. (ASCC 2006)

Detection of early hearing loss.

According to Berger 2003, *"what is needed is not the development of new solutions but rather the broad dissemination of existing techniques plus the education and motivation of management and labour alike to speed the implementation of effective programs"*.

Hearing impairment beyond temporary threshold shift is irreversible. Therefore, it is imperative to prevent hearing loss and have health surveillance programs designed to detect early stages of hearing loss, not identify significant permanent impairment.

According to AS/NZS Occupational noise management, p.4: Auditory assessment defines a significant threshold shift as:

A threshold shift greater than or equal to 15dB at 500, 1000, 1500 or 2000Hz or greater or equal to 20 dB at 8000Hz in either ear; a change in mean threshold greater than or equal to 10 dB at 3000 and 4000 Hz or greater than or equal to 15 dB at 6000 Hz in either ear; or a change in average threshold at 3000, 4000 and 6000 Hz greater than or equal to 5 dB in either ear.

A simpler approach to detect early hearing loss is that prescribed by the US Occupational Safety and Health Administration (OSHA) has defined a standard threshold shift:

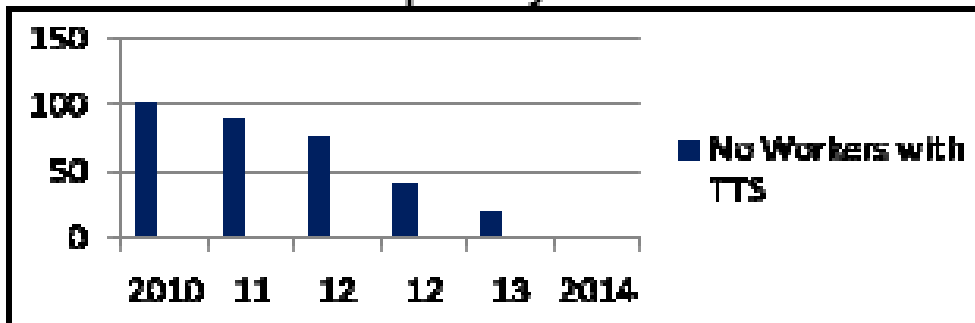
A change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000 and 4000 Hz. In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of ageing (presbycusis) to the change in hearing level by correcting the annual audiogram by incorporating a correction for hearing loss from ageing.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9735

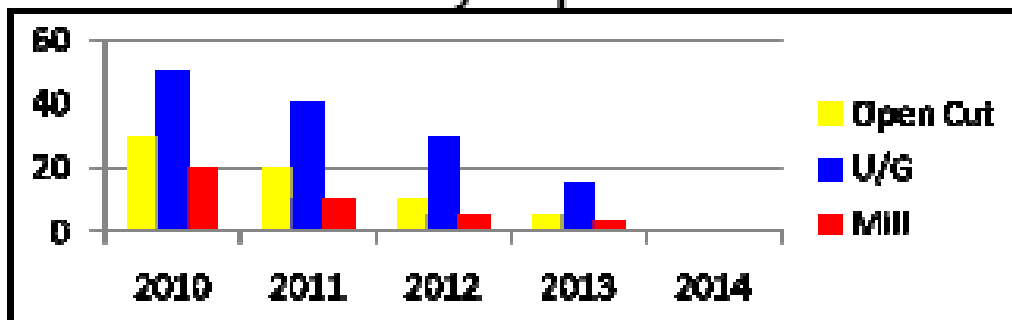
It is important that health surveillance tracks the number of cases of standard threshold shift. An average 10 dB temporary threshold shift may indicate unacceptable noise exposure.

Performance measures

Incidence of Temporary Threshold Shift :



Incidence of TTS by Department



Source: Dr Sharann Johnson – President AIOH

Courtesy of Sharann Johnson: 2009 President of Australian Institute of Occupational Hygienists (AIOH). Presentation - to Minerals Council of Australia (2009).

The number of cases of threshold shift with an age adjusted average greater than 10 dB can also be grouped in similar exposure groups (SEGs). This would assist sites rank and prioritise noise abatement measures so that resources could be focused on SEGs identified to be most at risk.

Evaluating the effectiveness - of hearing protectors.

The attenuation provided by a hearing protector is strongly dependent on the way in which the wearer fits the ear plug. This leads to a wide variation in reported attenuation. Reliance can not be placed on the manufacture's rating as this is determined under laboratory conditions and assumes perfect fit, albeit adjusted down by one standard deviation.

There are test units with software on the market to test the effectiveness of ear plugs while they are being worn. This type of instrument identifies the actual protection an employee receives in each ear. It is also a good training tool and demonstrates the importance of correct fitting of ear plugs.

Conclusion.

Health surveillance should be carried out to prevent hearing loss. For higher risk operations annual audiometry is recommended. The OSHA approach is simple and can be used to identify a standard threshold shift (STS). This will provide an early warning of the likelihood of permanent noise induced hearing loss and prompt early intervention.

Due to the large variability in attenuation, offered by hearing protectors (ear plugs), testing the plug while it is fitted, will provide a better indication of effectiveness than simply relying on the rating provided by the manufacturer.

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