jurisdictions included age-adjustments, tinnitus, apportionment among employers, hearing aids, hearing protection use, and duration and length of noise exposure. A detailed summary of the survey results appears in the referenced chapter.

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EVALUATION OF HEARING CONSERVATION PRACTICES IN AN INDUSTRY WITH A HIGH RATE OF WORKERS' COMPENSATION CLAIMS FOR HEARING LOSS. S. Swan, University of Washington, Seattle, WA.

Washington State has experienced a huge increase in the number of workers' compensation claims accepted each year for hearing loss. The annual costs of disability compensation rose twenty-fold in a decade, exceeding 40 million dollars in 1998. To determine whether there is any ongoing risk for hearing loss in industries with high rates of hearing loss claims, this pilot project evaluated noise levels and hearing conservation practices in one industry, foundries. The University of Washington and the state Department of Labor and Industries collaboratively evaluated ten representative foundries in the Seattle area (cross-sectional design). The project included personal noise dosimetry (n=86), structured interviews of management representatives (n=10) and employees (n=125), and review of existing audiometry files (n=306). Summary scores were created for management and employee interviews; higher scores represented better awareness and practices. A hearing loss rate was calculated for employees with 3+ years of audiometric tests (average hearing threshold change at 2-3-4 kHz); only eight worksites had conducted testing (n=146). Noise levels routinely exceeded 85 dBA at all worksites. All companies were out of compliance with hearing conservation regulations. There was no significant association between management-interview scores and worksite average employee-interview scores (r=0.44). The worksite-average hearing-loss rates showed no clear relationship with average noise levels (r=-.45), management-interview scores (r=-.03), or average employee-interview scores (r=-.50); however, excluding one "outlier" worksite, there was a strong inverse association between hearing loss rates and employee-interview scores (r=-.94, p<.001). Based on observed noise levels and deficiencies in hearing conservation practices, workers in this industry probably still face a risk of occupational hearing loss. The rate of hearing loss was lower at worksites with higher overall worker awareness of noise hazards, indicating that hearing conservation is most likely to be effective when companies successfully maintain a broad base of hearing safety consciousness.

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NOISE EXPOSURE ASSESSMENT METHODOLOGY AND YEAR ONE RESULTS OF A FOUR-YEAR PROSPECTIVE STUDY OF NOISE-INDUCED HEARING LOSS IN CONSTRUCTION APPRENTICES. R. Neitzel, N. Seixas, S. Brower, K. Thomas, L. Sheppard, University of Washington, Seattle, WA.

An occupational and recreational noise exposure assessment strategy was developed for a four-year prospective study of noise exposures and hearing loss in construction apprentices. Enrolled subjects include apprentices from 11 building trades and university student controls. Historic and current exposures to noise and ototoxic agents are assessed through a combination of repeated noise dosimetry, questionnaire administration, and self-report activity cards.

Baseline questionnaires regarding noise exposure history, medical background, and work history have been administered to 231 apprentices and 63 controls, and 40 apprentices and 43 controls have completed two-day activity cards logging their activities and noise exposures. An additional 35 apprentices and 14 controls have completed two-day activity cards while simultaneously wearing datalogging noise dosimeters configured to measure noise exposures according to OSHA and NIOSH metrics. Dosimetry measurements are 40 hours in duration, spanning two workshifts and the intervening (non-workshift) period.

NIOSH TWAs from apprentices and controls differed significantly ($p<0.001$): apprentices had workshift and non-workshift TWAs of 84.2 and 80.0 dBA, respectively, while control TWAs were 73.5 and 74.6 dBA, respectively. The trade with the highest average TWA work exposure was carpenter (95.9 dBA), while the lowest average TWA work exposure was for thermal insulator (76.8 dBA). On average, over 2 hrs of monitored time per apprentice sample exceeded 85 dBA, compared to only 10 min for controls. Approximately 75% of apprentices and controls reported noisy recreational activities. However, apprentices were significantly more likely to have previous ear and head injuries, experience tinnitus, operate power tools, shoot firearms, and have military experience. One-minute noise level data and task card information were assembled into an exposure model to develop precise task exposure matrices. The final evaluation of this prospective study, including several types of noise exposure data, will be integrated to form a basis for analysis of longitudinal noise-induced hearing damage.

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FIELD EVALUATION OF THE BONE CONDUCTION LOUDNESS BALANCE METHOD FOR MEASURING HEARING PROTECTOR ATTENUATION. T. Rimmer, L. Ording, University of Arkansas for Medical Sciences, Little Rock, AR.

A previously developed procedure for field measurement of the attenuation of any hearing protective device (HPD) has been modified for efficient usage in workplace hearing conservation programs, tested and evaluated. The procedure, bone conduction loudness balance (BCLB), uses a reference bone conduction sound to enable HPD wearers to determine the decrease in airborne sound level caused by the HPD presence. In the latest version of this procedure, software in the form of an MS Windows® program written for use in most personal computers has been developed and tested to evaluate attenuation at 250, 1000, and 4000 Hz. The hardware consists of a personal computer with a stereo sound card, ordinary powered loudspeakers and a bone conduction transducer. Feasibility testing as part of the hearing conservation program in two industrial plants has shown the ability of most workers to use the BCLB method as easily as ordinary hearing tests, although 22% initially required a repetition of the normal instructions to understand the test. Consistency on test-retest comparisons showed that over 80% of comparable values are within one step size (3 dB) and the time required for the BCLB test (including instructions) averaged 6.7 minutes, less than the time required for the hearing test. Since the use of a strap around the head is not possible for candid testing of earmuffs, a comparison was made of the difference in strap holding versus hand holding of the bone conduction vibrator, with a mean difference of only 0.75 dB.

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APPLICATION OF THE HEARING CONSERVATION STANDARD IN LARGE COMMERCIAL FACILITIES. L. Horgan, Assessment, Resources, & Technologies, Inc., NYC, NY.

Large commercial office facilities have many systems and components capable of producing excessive noise levels. Such components usually consist of HVAC, electrical, elevator, and plumbing systems. Engineers are employed to monitor, maintain, and repair these systems. These engineers are covered under the Occupational Safety & Health Administrations Hearing Conservation Standard (29 CFR 1910.95). This standard requires employers to evaluate employee noise exposure and develop a Hearing Conservation Program. To comply with the OSHA requirements, four large commercial office facilities were monitored over a five-year period. Periodic surveys were conducted on a routine basis and whenever there was an equipment or procedural change. The survey included sound level surveys at locations throughout the facilities and employee noise dosimetry. The surveys indicated that many facility components produce noise levels greater than the OSHA Action Level of 85dBA. However, noise levels were dependent on the number of components running and the acoustical characteristics of the location. The personnel noise dosimetry surveys indicated that the facility engineers had the potential for exposure to noise levels greater that 90dBA. However, the potential for exposure was dependent on a wide variety of factors. Therefore, monitoring was designed to evaluate heating season, cooling season, routine maintenance, and special maintenance activities. Results of the noise dosimetry were then used to develop and implement a Hearing Conservation Program. An effective Hearing Conservation Program needs to contain elements that involve and educate the facility engineers. Therefore, hearing conservation was included as part of the annual Hazard Communication Program. Noise surveys and personnel dosimetry results are reviewed with the engineers and their input was actively sought to reduce exposures. As a result of this input, workable administrative controls (time limits in high noise areas) were established, certain maintenance procedures were modified, and personnel protective equipment selection incorporated worker preferences, resulting in reduced noise exposure.

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EVALUATION OF OCCUPATIONAL NOISE EXPOSURES TO AIRBOAT BASED AQUATIC HERBICIDE APPLICATORS. R. Maglievaz, Volusia County Health Department, DeLand, FL.

Airboats have been used since the 1940s as the transportation of choice during invasive and exotic aquatic plant eradication efforts. There is an industry recognition that airboats pose a noise hazard. Despite this recognition, the prevailing literature is suprisingly lacking in the discussion of occupational noise exposures caused by airboats and exposures specifically to aquatic herbicide applicators. The purpose of this research is to document the typical levels and sources of noise on airboats, to evaluate the effectiveness of various engineering control methods used in the industry and to evaluate the effectiveness of commonly used hearing protection devices. Noise sources, specifically the propeller, engine, exhaust, granulator and sprayer are measured using a Quest Model 1900 integrating and logging

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ABSTRACTS