

AN ASSESSMENT OF THE HEARING CONSERVATION
PRACTICES AT COMPANY XYZ

by

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A Research Paper

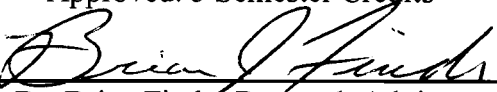
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ABSTRACT

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This research paper assessed the hearing conservation practices at Company XYZ's metal fabrication facility. The goals of this study were to collect and assess the current noise levels that exist within the production areas of Company XYZ, identify the extent that the current personal protective equipment used by the employees at Company XYZ was able to adequately protect their hearing, determine the extent that employees are complying with the current hearing conservation policy as set forth by Company XYZ, and to identify the extent that employees have been trained on the proper use of hearing protection devices.

This study was performed using noise dosimeters to assess the noise levels generated from metal fabrication processes. Casual observations were made as to how many employees were wearing hearing protection devices by tallying those who were wearing the hearing protectors over the total number of employees seen. The results were

presented in percentage form. The results of the monitoring indicated that the noise levels within Company XYZ's manufacturing areas averaged between 59dB and 89dB (L-Average in the tables). The peak levels ranged from 112dB to 145dB indicating that the impact noise can reach very high levels which are the sounds most damaging to the ears.

Training was provided by a contractor which entailed watching a brief video about the delicate cells and functions of the ear. The video also discussed the importance of wearing hearing protectors and the process of the audiometric tests. One strong point that video emphasized was the fact that only individual employees can protect their hearing through wearing their hearing protection devices.

The type of hearing protection devices used by the employees consisted of foam earplugs. These came in the form of canal caps and un-corded disposable earplugs. Their noise reduction rating (NRR) ranged from 23 to 33. In a comprehensive review of the process of this research, it was discovered that employee compliance levels were low due to the fact that there was a lack of enforcement. Recommendations included taking disciplinary actions on those employees not wearing hearing protection devices, have hands-on training, and perform a more thorough noise monitoring analysis that would encompass the entire working shift.

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Most importantly, this accomplishment is dedicated to all my children, Teing (8), GoldHuaku (7), Shuayin (5), NtueTshia (4) and DuaZong (1), my motivation and inspiration to keep on going when I wanted to give up. I also devote this degree to my brother Ue Yang.

Finally, it is with pride that I share this Master's degree with my husband Chou Lor.

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CHAPTER I: INTRODUCTION

It appears that sounds occur in many activities that people partake in, whether they are mowing the lawn, watching a movie, or working on the job. When unwanted sounds reach an excessive level, they become noise. In some instances, noise can cause people to have the inability to concentrate or focus on certain activities, such as studying. Moreover, when these sound levels reach 85 decibels or higher, they become hazardous noise (Denniston, 2000). In the work force today, there are nearly 30 million workers exposed to excessive noise levels. Furthermore, loud noise exposures can affect workers on the job by causing fatigue, irritability, and stress. Given the many workers who are exposed to excessive noise levels, it is likely that they may incur hearing loss in the workplace.

Company XYZ is a metal fabrication company which employs approximately 60 employees in the Midwestern part of the United States. Because of their fabrication processes, there are noise exposures that place employees at risk of developing hearing loss. In order to prevent hearing loss, Company XYZ instituted a hearing conservation program (HCP) that performs yearly audiometric testing to ensure that employees have not sustained adverse effects from the noise exposure. In addition, Company XYZ offers their employees the use of personal protective equipment (PPE) such as earplugs. However, there has been a compliance issue as to using the ear plugs consistently and appropriately.

In a review of Company XYZ's past years' Occupational Safety and Health Administration (OSHA) logs of recordable injuries, there was a significant threshold shift (STS) (i. e. substantial hearing loss, a change in 25 decibels or greater) in the hearing of

one of their employees. Furthermore, a comprehensive survey of noise levels has not been performed in the facility for several years as part of the HCP. Consequently, a failure to perform periodic employee noise exposure monitoring at Company XYZ is placing the employees at risk of developing potentially long-term hearing loss.

Purpose of the Study

The purpose of this study is to assess the hearing conservation practices for employees who work at Company XYZ's metal fabrication facility.

Goals of the Study

The goals of this study are to:

1. Collect and assess the current noise levels that exist within the production areas of Company XYZ.
2. Identify the extent that the current PPE used by the employees at Company XYZ is able to adequately protect their hearing.
3. Determine the extent that employees are complying with the current hearing conservation policy as set forth by Company XYZ.
4. Identify the extent that employees have been trained on the proper use of hearing protection devices.

Background and Significance

There are two primary justifications as to why it is necessary to conduct this noise study on Company XYZ's metal fabrication facility. First of all, it becomes undesirable to accumulate OSHA recordables on STS from a risk control standpoint. The number of OSHA recordable injuries that occur typically reflect a company's workers' compensation costs, which ultimately affect its bottom line. This alludes to the fact that

injuries are just as critical to control as it is substantially significant to increase profits. In addition, companies that accumulate OSHA recordables on STS indicates that the company may not be in compliance with the hearing conservation program set forth by OSHA and the National Institute for Occupational Safety and Health (NIOSH, n. d.a).

Secondly, from an asset protection standpoint, it is in the best interest of Company XYZ to preserve the hearing of their employees. This is of utmost importance not only in terms of governmental compliance issues and degraded performance in the workplace but also the quality of life for their employees outside of work. Consequently, this study would greatly assist Company XYZ to determine their level of hearing compliance with governmental regulatory bodies as well as protect their employees who are the company's greatest asset and resource.

Assumptions of the Study

- All information provided by Company XYZ is accurate and correct.

Limitations of the Study

The limitations of this study are:

- There was a time limit of four months to complete the study.
- The study and results only pertain to Company XYZ and may not be useful for other companies.

Definitions of Terms

Listed below are the definitions for common terminology used while conducting the noise study. They are as follows:

Audiogram. “A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency” (OSHA, 1996a, para. 2).

Baseline audiogram – “The audiogram against which future audiograms are compared” (OSHA, 1996a, para. 4).

Decibel (dB) – Sound level units (OSHA, 1996a).

NIOSH – The research arm for OSHA.

Noise dosimeter – “An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose” (OSHA, 1996a, para. 9).

OSHA – The Occupational Safety and Health Administration, a governmental body that enforces occupational safety issues such as noise, fall protection, hazard communication, and etc...

Time-weighted average sound level – “That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured” (OSHA, 1996a, para. 14).

CHAPTER II: LITERATURE REVIEW

Introduction

The purpose of this study was to assess the hearing conservation practices for Company XYZ to determine the level of noise to which their employees are exposed. The body of the text will discuss the extent of the noise problem in corporate America as well as in other industrialized countries, the sensitive anatomy of the ear, adverse effects of noise on the human, OSHA requirements of a hearing conservation program (HCP), types of available hearing protection devices, common counter/enforcement strategies, and a summary of the research. Essentially, the literature review will provide insights into the noise exposure levels and compliance issues for employees who work at Company XYZ's metal fabrication facility.

In general, noise can be broken down into three classifications: continuous, intermittent, and impact or impulse noise (NIOSH, n. d.b). Continuous noises are constant sound levels usually generated from grinders, lathes, and power equipment. Intermittent noises come from a range of power tools in which the noise has a gap between repetitions. Impulse noises are generated from impact tools as jack hammers or explosives and usually are a sharp burst of noise lasting half a second in duration. All of these different types of noises will have a slightly different effect on the human ears.

Extent of the Hearing Problem

In order to fully understand the seriousness of the hearing loss dilemma in corporate America today, literature regarding the extent of the hearing problem needs to be reviewed. According to Pamela Penney and Catherine Earl of the American Association of Occupational Health Nurses Inc., noise induced hearing loss is the second

leading self-reported occupational injury among working Americans. As a result of this, it was estimated that from 1984 to 1993, noise induced hearing loss attributed to \$3.4 billion in workers compensation claims (Penney & Earl, 2004). Furthermore, researchers at NIOSH attest that noise in the work place is placing workers at risk of developing premature hearing loss. Their research concludes that by the age of 25, the average carpenter has 50 year-old ears. Noise in the construction industry is very common and usually inevitable. As a result workers have developed a mentality that noise is a normal part of the job (Nash, 2003).

Hazardous occupational noise appears to be a common problem in every industrialized nation around the world. In the United States, despite OSHA regulations, workers are still not adequately protected from hazardous occupational noises. For example, OSHA estimated that even with compliance, approximately 162,000 workers will still suffer irreversible hearing loss (Rekus, 1993). Employers need to be aware of the fact that OSHA regulations are the bare minimum and to significantly protect workers from hazardous occupational noises will take more than just being in compliance with the regulations. More importantly, employers can be compliant with the regulations in every way but when there is a significant hearing threshold shift (STS) or an injury/illness, OSHA can still cite an employer. This essentially requires employers to carry out safety activities beyond the minimum requirements of the regulations in order to prevent employees from sustaining hearing loss.

It appears that noise is likely a consequence of industrialization. Tim Turney (2004) writing in the Safety and Health Practitioner in the United Kingdom (UK) estimated that more than two million workers were exposed to unacceptable levels of

noise at work and about 170,000 workers suffer deafness, tinnitus and other adverse ear conditions. Part of the extent of this problem resulted from the fact that UK legislations only advise employers to notify their workers to wear hearing protection when noise levels reach 85dB or 90dB over an eight-hour period, but compliance to the regulation is not mandatory.

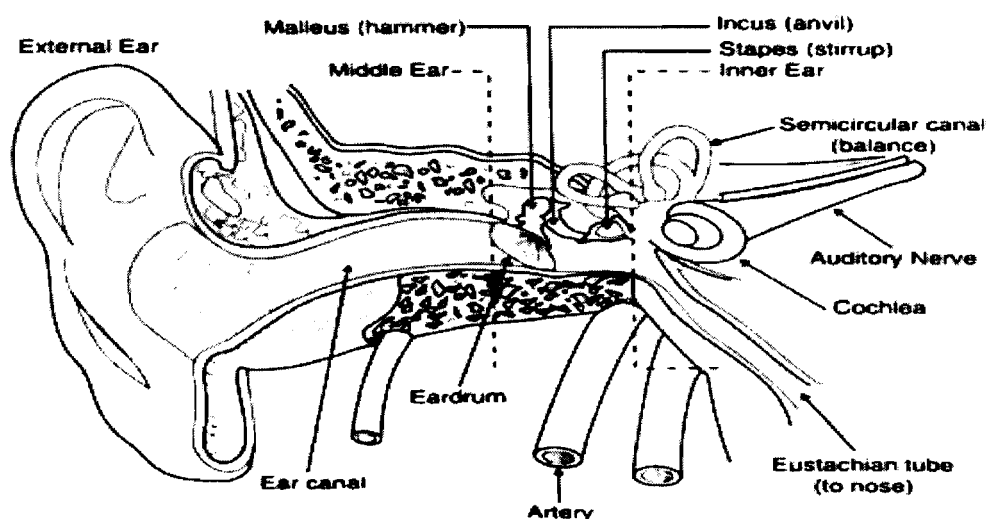
There are other major problems that come with high levels of exposure to occupational noise. According to Atkinson (2000), the most serious problem of noise is not from reduced productivity, hearing loss, or an inability to concentrate. The real danger is that loud noises can drown out warning alarms, causing a potential for employees to be killed or injured. Also nearly as important is that it hinders communication to the point where co-workers no longer talk among themselves and employees no longer communicate with their bosses (Atkinson, 2000). Consequently, excessively high levels of noise have a potential to cause psychological as well as physical stress on the human body.

Anatomy of the Ear

In order for a person to fully appreciate the gift of hearing, it is important to understand the workings of the delicate ear and the exposures or injuries that can result in hearing loss. The ear is designed to transfer sound waves from the environment to the brain through nerves (Hope for Hearing Foundation, 2005). There are generally four sections of the ear such as the external ear, middle ear, inner ear, and the transmission pathway. The external ear is composed of the outer flap of skin and cartilage and the external auditory canal, usually called the ear canal. The shape of the outer ear collects sound waves and funnels it through the ear canal to the eardrum. The eardrum separates

the external auditory canal from the middle ear. Sound enters the middle ear through the center, which is the most sensitive area of the eardrum which starts vibrating in response to the faintest sound. As the sound pressure increases, the vibration increases in a circular pattern, much like the pattern on water when a rock is thrown in. These vibrations are transmitted to the hammer, through the anvil, to the stirrup, thus transmitting airborne acoustic energy to the fluid of the inner ear. The middle ear must be filled with air, not fluid, and the three ear bones, with their muscles, must work easily together as a unit.

The inner ear is lined with delicate hair cells that send messages to the brain when sounds stimulate it. These delicate hairs function like a new carpet as when it is first walked on, the hairs spring up when new. However, over time like someone walking up and down the same area, the hairs get worn out and the hair is permanently bent or flattened. With short term exposure, the tiny inner ear hairs can spring up after a period of rest, but exposure to hazardous noise levels over time will flatten the delicate hairs causing permanent hearing loss (Young, 2003). The figure below shows the complex connections of the ear (Hope for Hearing Foundation, 2005).



<http://hope4hearing.org/anatomy.htm>

Adverse Effects of Noise on the Human

This section will review common negative effects of noise on the human body. In a study of patients with noise problems such as tinnitus, a constant ringing in the ear, Richard Carmen reported in an article called "Tinnitus & Hearing Loss," that such individuals have issues with getting to sleep, persistence of tinnitus, understanding speech, despair, frustration and depression, annoyance, irritation, inability to relax, concentration and confusion, dependence on drugs, and pain and headaches (1999). Also, it is worse upon awakening in the morning, and thus people with tinnitus may avoid noisy situations, among many other negative social aspects. Additionally, Carmen commented on the fact that old age hearing loss may be attributed to the accumulation of noise exposures over the person's life span. The author believed this to be a fact referencing that isolated tribes in the Sudan and Easter Island did not experience hearing loss as part of old age.

In a British study called "Prediction of Quality of Life in Patients with Tinnitus," the authors investigated how tinnitus affects people who are afflicted with this problem. In this study, about 85-90% of the population said of all the adverse problems tinnitus causes, the worst to deal with was that of decreased communication abilities (Erlandsson & Hallberg, 2000). In essence, tinnitus has greatly affected their ability to socialize and lead a normal life. Many report that tinnitus has diminished their quality of life as some think of it as a disability affecting their personal and professional growth. Those who perceived tinnitus as a constant or non fluctuating sound are more disturbed than those who perceived their tinnitus to fluctuate. This may have a significant influence on the quality of life of the individual because people who have fluctuating tinnitus may have a

brief break. Between the two studies described here, there are many similarities in terms of the effects and symptoms of tinnitus. The bottom line is that tinnitus severely limits people's ability to lead a normal life.

In addition to the hearing-related issues associated with noise exposure, it appears that other negative health affects are common. Talbott, Gibson, Burks, Engberg, and McHugh conducted a study of the dose-response relationship between occupational noise and blood pressure for workers at two metal fabrication plants (1999). They compared two groups of workers with different levels of noise exposures. The group from plant A experienced noise levels that were greater than or equal to 89 dB and the group from plant B had noise exposures less than or equal to 83 dB. All the study participants were male and there were 329 workers in plant A and 314 workers in plant B. Their ages ranged from 40 to 63 years and the mean age for plant A was 49.6 and plant B was 48.7. All of the workers had worked in their plant for at least 15 years. The investigators discovered that indeed there was a correlation between loud occupational noises and hearing loss. On the whole, workers from plant A experienced more threshold effects but blood pressure was insignificant for both groups. This is contradictory to common sense since hazardous noise levels are annoying and this annoyance has led workers to incur psychological stress and increased blood pressure may be a direct result of noise exposure.

In contrast to the Talbott et. al. study above, another noise relationship study conducted by Hessel and Sluis-Cremer (1994), the authors found no associations between noise exposure and blood pressure. This longitudinal study also included personal traits such as body mass index (BMI). The authors concluded that it was BMI that had a greater

influence on blood pressure than noise exposure. The results of this study led the researcher to believe that perhaps noise exposure and blood pressure only have a strong correlation if the job is complex.

The adverse effects of occupational noise exposures do not appear overnight, making employers and employees alike disregard the long term hazards of noise, argued Elaine McShulskis (1997) in her article “Protect Employees from Hazardous Noise Levels.” Most people do not consider hearing loss to be a life threatening disease and they fail to realize is that hearing loss from high levels of sounds is irreversible in long term situations. Research has indicated that workers who expose themselves to noise outside of the workplace develop more severe hearing loss than those who do not engage in recreational activities. For example, a study conducted in 2001 by Stewart, Konkle, and Simpson compared 278 industrial workers who engaged in recreational shooting with 278 individuals in a control group to determine the extent that recreational shooting had on hearing thresholds. The results indicated that the experimental group experienced a hearing sensitivity decrease of 5 to 10 decibels lower than the control group. In addition, older shooters had more hearing asymmetry than younger shooters, indicating that engaging in recreational shooting does cause greater shifts in hearing thresholds (Stewart, Konkle, and Simpson, 2001).

In a study called “Hearing Loss among Workers at an Oil Refinery in Taiwan,” the authors investigated whether hearing shifts still occur after a 15-year exposure to high frequency noise (Chen & Tsai, 2003). An early symptom of high frequency noise impairment includes a loss of clarity of perceived speech which can eventually interfere with daily living activities. Most of the time, workers with hearing loss will turn up the

volume on radios and television, have trouble understanding everyday speech, and even experience tinnitus. The authors concluded that contrary to other studies, workers still experience worsening of hearing threshold shifts after 15 years. Of the workers that experienced hearing threshold shifts, the most notable comments were that they have trouble hearing.

OSHA Hearing Conservation Requirements

OSHA requires employers to monitor noise in the workplace, perform annual audiograms, provide PPE, train, and keep records on activities related to a HCP. As part of the OSHA requirements, employers need to institute a HCP if the work exposes workers to unsafe noise levels over the worker's lifetime (OSHA, 1996b). The HCP requires employers to monitor noise exposure levels to accurately identify whether or not employees are exposed to noise levels above 85 dB over a time-weighted average (TWA). All monitoring needs to reflect the three classes of noise that can occur in the workplace: continuous, intermittent, and impulse noise.

In addition to the noise monitoring requirements, audiometric testing must be performed to monitor a worker's hearing over time to determine if there are threshold hearing shifts (OSHA, 1996b). This is important in that it presents an opportunity for employers to educate their employees about the critical issue of utilizing the appropriate protection devices in order to preserve their hearing. All employees admitted into the HCP need to have a baseline audiogram with which future tests are compared to determine the sensitivity of their hearing. Usually, there after, yearly audiometric tests are conducted to monitor the employee's hearing.

Regarding the availability and use of hearing protection devices, employers need to provide PPE for employees to wear when they are exposed to noise above 85 dB over an eight hour period, and must require such to be worn when or any noise is above the action level of 90 dB (OSHA, 1996b). Also, hearing protection needs to be given to employees who are more susceptible to hearing loss. Employers must provide at least one variety of ear plugs and one variety of ear muffs for workers to choose from. These forms of PPE must be able to significantly reduce the level of noise that ultimately reaches the employee's ear drum (OSHA, 1996b).

Due to the presence of employee training being specified in the OSHA hearing conservation standard, it can be surmised that this activity is a fundamental aspect of a HCP. The basics of any employee training should cover the effects of noise on hearing, purpose of hearing protection devices, advantages and disadvantages, attenuation of various types, and instructions on selection, fitting, use, and care. In addition, the purpose of audiometric testing and an explanation of the test procedures should be included (Cornell University, n. d.). One could reasonably ascertain that employees who realize the danger and respect the sensitive nature of their hearing will be more likely to understand the purpose of the HCP and be more willing to protect their hearing. Proper and timely training could not only promote the employee to properly wear hearing protection on the job, but off the job as well. In this sense, it is likely that they will be more proactive at looking after their hearing-related health.

Another component to the HCP is recordkeeping (OSHA, 1996b). All records must be kept whether they are training records or audiometric testing records. Noise exposure records are kept for 2 years and audiometric testing records are kept for the

duration of the worker's employment with the employer. Information such as employee name, job, etc. need to be on record and the condition of the testing room and other activities must be documented.

Types of Hearing Protection

Hearing protective equipment comes in a variety of shapes, sizes and colors. When selecting hearing protection devices, one should make sure the hearing PPE is correct for the job, capable of providing adequate protection, and comfortable for employees to wear. There are three types of available hearing protection PPE. Ear plugs are inserted to block the ear canal and these can be premolded or moldable where they come in the form of foam and can be shaped to fit the worker's ear canal. Semi-insert ear plugs come in the form of two ear plugs that are held over the ends of the ear canal by a rigid head band. This type seems to provide the least comfort, but it can provide adequate protection against noise. The last type is like an earmuff, except it is a sound attenuating material that fits around the ear and hard outer cups. These are also held together by a head band. Although this type of hearing protection can offer superior protection, it may not be very suitable in the summer when the weather is hot and workers sweat easily. Some workers may find it to be uncomfortable for this reason.

Common Counter/Enforcement Strategies

The authors of a study called "Applying Mathematical Modeling to Create Job Rotation Schedules for Minimizing Occupational Noise Exposure," offer an administrative strategy to reduce the occupational noise exposures of workers (Tharmmaphornphilas, Green, Carnahan, & Norman, 2003). The authors indicate that by following this strategic model of job rotation, workers will be exposed to noise levels

that are less than the what the regulation permits. One of the reasons why companies often experience hearing loss incidents is that the current OSHA law is not enough to prevent hearing loss. OSHA standards are the bare minimum protection.

One important aspect of instituting an effective noise conservation program is to give employees choices. Among other things would be comprehensive training on hearing protection, proper fitting, and how best to achieve comfort for long wear (Denniston, 2000). McShulskis (1997) also stated that is the reason why employees often refuse to wear hearing protection. Most of the time, it is comfort. Consequently, providing employees with choices will result in a higher likelihood of workers wearing hearing protection.

Noise induced hearing loss is something that can be preventable, however, some companies fail to provide adequate hearing conservation programs. These companies seem to be missing key components that make hearing protection possible. For example, they may be missing adequate noise assessment and monitoring systems (Nighswonger, 2001). In a study conducted by Rabinowitz and Duran (2001), employees with limited English proficiency may post a special challenge for hearing conservation programs. Their research focused on employee knowledge, attitudes, and behavior regarding the use of hearing protection equipment. The study population was mainly Hispanics but also included some Asians. The study demonstrated that the level of hearing protector fit and level of English language skills was directly related. This is a challenge as when hearing protection is used by employees who have a hard time understanding English.

Nighswonger argues that if employers take step to ensure a complete hearing conservation program, will more likely value their hearing (2001). What hearing

conservation programs may fail to address is that hearing should be considered an asset that needs to be protected. Less attention has been paid to hearing loss because hearing loss occurs slowly over time. Some people consider it to be less serious than radiation or chemical exposure. Just simply performing audiometric testing may be too simple, because in some cases, employers could file away these results and never deal with them again.

In a European study, a team of researchers put together a database that would help employers track the recreational activities, illnesses, and occupational noise in the workplace. The idea of this program or database is to allow employers and employees alike to determine whether or not the hearing loss that employees incurred was a result of occupational noise or was it personal traits and attributes (Pyykko, Toppila, Starck, Juhola, & Auramo, 2000). It appears that creating and maintaining this database would allow employers to screen for workers who may be at risk in particular tasks, warn against the noise hazards of a particular work site, compare the successes and limitations of HCP, and call attention to individual susceptibility.

Turney (2004) suggested that most businesses would benefit a great deal by purchasing quieter machines which would eliminate the very high sounds that can go up to 110 dB. He also states that many people, about 10%, do not comply with hearing conservation programs. Again, as mentioned by other researchers, the number one reason why employees do not wear hearing protection is the level of discomfort that they experience.

According to Klane, simply offering hearing protection to employees is not enough, as it should really be the last resort to be implemented. Companies should seek

to engineer out the problem (Klane, 1998). The point is that an effective hearing conservation program should not begin and end with hearing protectors. Both employers and employees need to be made aware that losing hearing is very different from losing eye sight. Vision can be corrected with corrective lenses and with hearing the problem is much more complex. For people with severe hearing loss, even hearing aides do not help much.

In a study conducted in Taiwan on oil refinery workers, it was found that self reports of noise induced hearing loss was the best indicator of workers sustaining hearing loss. When workers report having hearing loss, employers need to investigate further as this provided an opportunity for employers to evaluate the effects of noise on their workers (Chen, 2002).

According to Martin, the presence of excessive noise in the workplace is a leading cause of hearing loss. This is a problem in North America and the ways to reduce the problem is by educating people about the sources and effects of noise exposure. Secondly, there are generally three methods that noise exposures can be minimized and they are, in hierarchical order, engineering control, administrative control, and PPE (Martin, 2002).

Summary

A review of the literature suggests that the development and implementation HCP need to be based first on engineering controls. The research suggests that employers have over sighted OSHA regulations. The regulation indicates that PPE should only be used after all other measures have been exhausted. However, for many employers, PPE has been the first line of defense against hazardous noise. For this reason, many HCP were

ineffective. The literature also indicates that for a HCP to be effective there must be education and training about the importance of hearing and the effects noise has on hearing ability. All employees need a baseline audiogram to compare future evaluations with. Just as important is the wearing of PPE, wearing it properly will have a huge difference on significant hearing threshold shift. The research recommends telling employees about how precious hearing is. One must think of it as an asset and how important it is to protect it from damage, because no one realizes how precious something is until it is gone.

CHAPTER III: METHODOLOGY

Introduction

The purpose of this study was to assess the hearing conservation practices at Company XYZ's metal fabrication facility. The purpose of the methodology was to explain the process through which this study was conducted. The goals of the study were to:

1. Collect and assess the current noise levels that exist within the production areas of Company XYZ.
2. Identify the extent that the current PPE used by the employees at Company XYZ is able to adequately protect their hearing.
3. Determine the extent that employees are complying with the current hearing conservation policy as set forth by Company XYZ.
4. Identify the extent that employees have been trained on the proper use of hearing protection devices.

Included in this chapter is a review of the population, instrumentation, and data collection procedures, data analysis, employee observation, and limitations of the study.

Population

The population of subjects included in this study numbered approximately 60 employees whose job duties exposed them to hazardous noise levels. The number of years of employment varied greatly as the company has been in existence for quite some time. All subjects were male ranging in appearance from very young to those of middle-aged. Subjects were very kind, knowledgeable, and helpful.

Instrumentation

Noise dosimeters were used to monitor area noise throughout the metal fabrication facility work areas to determine an accurate representation of the noise exposure level. The noise dosimeter instruments were calibrated according to the manufacturer's recommendations prior to and immediately after the noise monitoring was performed.

Data Collection Procedures

Noise dosimeters were set up at different workstations within the metal fabrication facility. After setting up the noise dosimeters, a walk-through was performed to determine how many employees were actually wearing their hearing protection ear plugs. The routine was replicated five different times as the work Company XYZ performs is different from day-to-day and therefore, the noise exposure can vary greatly from one work activity to the next.

Data Analysis

The data from the noise dosimeters was analyzed to determine the extent of noise levels that vary with each activity. One of the purposes for performing the noise monitoring was because each work activity can exude a different noise level. Since the work that Company XYZ performs is not consistent, the noise levels are also not uniform. By using the data to determine which job activities produce the highest sound levels, employees can be informed on how they can protect their ears by using more efficient ear protection equipment. The data will also be used to determine if the PPE that Company XYZ provides is adequate in protecting their workers from the noise levels.

With the walk through observation of employees, the researcher will determine the extent to which employees comply with the HCP set forth by Company XYZ. This information is vital to understanding the number of significant hearing threshold shifts that the company has been experiencing.

Employee Observation

In order to fully assess the effectiveness of Company XYZ's hearing conservation program, a walkthrough was performed every day for a week to determine the number of employees who were wearing their PPE. No names or questions were asked. This was performed strictly through observation and statistically counting the number of employees with hearing protection and those without. This data then was used to determine the level of compliance with Company XYZ's hearing conservation program.

Training

Materials for the training were reviewed to determine if the training covered what the regulations require, such as the purpose of the hearing conservation program, advantages and disadvantages of various types of hearing protection devices (HPDs), the proper use, care and maintenance of the HPDs and purposes of the audiometric tests.

Limitations of the Study

The researcher believes that using data-logging dosimeters on employees would have yielded more accurate result as to the extent of noise exposure.

Summary

This chapter covered the purpose of the methodology, how data was collected and analyzed. The information covered here were overflows from the two previous chapters as well. That information was needed in order to structure data collection.

CHAPTER IV: RESULTS AND DISCUSSION

The purpose of this study was to assess the hearing conservation practices at Company XYZ's metal fabrication facility. The goals of this study were to:

1. Collect and assess the current noise levels that exist within the production areas of Company XYZ.
2. Identify the extent that the current PPE used by the employees at Company XYZ is able to adequately protect their hearing.
3. Determine the extent that employees are complying with the current hearing conservation policy as set forth by Company XYZ.
4. Identify the extent that employees have been trained on the proper use of hearing protection devices.

This chapter will discuss the results of the study. The data will be presented in four sections. The first section will present the results of the noise monitoring within the production areas. The second section will discuss whether the hearing PPE provided by Company XYZ was adequate in protecting the hearing of their employees. The third section will discuss the results of the compliance levels of employees in percentage form. Finally, the fourth section will discuss the training activities as they relate to the hearing conservation program.

During the data collection portion of this study, four M-27, data logging dosimeters were set up in various locations within the manufacturing facility of Company XYZ. The noise dosimeters have a capability to indicate various noise levels such as the impulse sound during the sampling period, the maximum level, and the L-Average (which is the average of all the recorded sounds during sampling). All dosimeters also

have the capability to provide exposure information in the form of dose which is in percent of the OSHA permissible exposure. Ideally, the TWA should only be used for an eight hour sampling as when sampling times are less than eight hours, the dosimeters assumes the unsampled time to be zero. This noise study only provides Company XYZ with an assessment of noise levels and not the exposure during an entire working shift. Consequently, if one relies on this information, the TWA values shown here are not accurate as the sample times were not based on eight hours or duration of the employees' work shift.

The data in Table 1 represents four hours of sampling time in which all workstations listed performed different types of metal work. The low bay area performs welding while the high bay area performs some welding and insulating of metal pipes. The noise dosimeter for the paint blast was placed outside rather than inside the area as it could easily become dirty. By placing the dosimeter on the outside of the area, however, the noise levels recorded are reduced to some extent. The North Building performs minor metal work, which the dosimeter recorded the lowest average in sound levels of all the sampled areas.

Table 1

Data for May 23, 2005, 7:00am – 11:00am (1st shift)

Dosimeter Number	Location	Peak Level	Maximum Level	L-Average	Dose	TWA
054	Low Bay	136.5	105.7	76.6	15.34%	81.9
055	High Bay	144.7	111	84.5	22.45	79.2
072	Paint Blast	120	94.8	84	20.86%	78.2
067	North Bldg.	112.5	91.8	59.1	.64%	53.7

Data recorded in Table 2 represents four hours of sampling time in the evening for the second shift employees. The pre-fabrication (pre-fab) area is where a laser is used to cut pieces of metal designed by engineers to complete certain projects. Station roller #9 is used for rolling and welding together large pieces of metal to form a cone shape cylinder. The low and high bay areas perform the same type of work as described above. There are significantly less people on second shift and therefore the noise levels are reduced to a certain extent.

Table 2

Data for May 24, 2005, 3:00pm – 7:00pm (2nd shift)

Dosimeter Number	Location	Peak Level	Maximum Level	L-Average	Dose	TWA
054	Pre-fab	135.3	108.3	74.3	5.64%	69.3
055	Roller #9	112.8	99.3	72.4	4.18%	67.1
067	Low Bay	126	105	74.2	5.26%	68.8
072	High Bay	124.5	98.6	68.4	2.30%	62.8

The work activities performed in Table 2 included some pounding activities in the Low Bay area that produced sound levels above 100dB, as measured on the A scale. The work processes that generate the loudest noises were the pounding actions such as pounding on a cone-shaped cylinder. Other activities such as grinding and welding metal edges together produced sound levels in the high 80 to 90 decibel range. However, the length of time a worker is exposed to these types of noise levels varies greatly on a daily basis.

Table 3

Data for May 25, 2005, 7:00am – 11:00am (1st shift)

Dosimeter Number	Location	Peak Level	Maximum Level	L-Average	Dose	TWA
054	Pre-fab	145.5	115.5	80.3	12.73%	75.1
055	Welding	133.1	113.2	86.3	29.08%	81.1
067	High Bay	117.7	105.3	83.3	19.41	78.2
072	Low Bay	121.8	107.6	84.4	21.93	79.1

Table 4 shows data for later in the first shift. The weld bay area performed welding that generated noise levels in the high 80 and 90 decibel range. Noise levels are not always consistent over time. Loud noises are generated from the specific job activities such as grinding and pounding while other sounds come from nearby workstations and activities. The low bay area had the highest sound levels as the job activities included more welding, while the other job activities processes generate less noise. For example, when metal pipes are insulated, noise levels are only generated by pounding, and when the pounding ceases to stop, the sound level is greatly reduced. Workstation roller #9 always involved rolling a large piece of metal and welding the ends together to create a large cone shape like cylinder. The loudest noise is generated by pounding to even out the shape and welding seams of the cylinder.

Table 4

Data for May 26, 2005, 1:00pm – 2:30pm (1st shift)

Dosimeter Number	Location	Peak Level	Maximum Level	L-Average	Dose	TWA
054	Weld Bay	123.7	102	76.4	3.76%	66.3
055	Roller #9	114.3	102	78	4.65%	67.9
067	Low Bay	116.6	101.2	89.5	24.1	79.7
072	Paint Blast	140.2	108.7	64.3	.70%	54.3

The data set for Table 5 is somewhat incomplete as one dosimeter was removed from sampling due to error. According to observations, it seemed that the noise levels generated in the pre-fab area are lower than those generated in the weld bay and high bay areas. However, this difference may be due to the fact that noise levels at the pre-fab area are more consistent while the noise levels at the weld bay and high bay can fluctuate greatly based on the work activities.

Table 5

Data for May 26, 2005, 3:00pm – 5:30pm (2nd shift)

Dosimeter Number	Location	Peak Level	Maximum Level	L-Average	Dose	TWA
055	Pre Fab	129	109.8	77.8	4.89%	68.3
067	Weld Bay	123.3	105.3	80.2	6.44%	70.2
072	High Bay	117.7	101.2	75.4	3.41%	65.7

Hearing Protection Devices

Company XYZ provides four types of hearing protection devices to their employees. The noise reduction ratings for each of the three hearing protection devices are 23, 25, 29, and 33 dBA. The hearing protection device with a noise reduction rating (NRR) of 23 is a canal cap. This type of hearing protection device was offered as an option to accommodate employees that need to wear other types of PPE such as a face shield when welding. The headband is made of plastic that can be worn over the head or under the chin with two disposable orange foam cushions attached to each end. This type of hearing protection device is easy to wear and versatile with other PPE.

The next hearing protection device is a pod plug that has a NRR of 25. This hearing protection device has a tiny handle on the end to hold while inserting into the ear canal. Another hearing protection device is an orange foam product that needs to be rolled with the tip of the fingers before inserting into the ear canal, and has a NRR of 29. The most efficient ear plug in terms of NRR that Company XYZ offers their employees is a white foam ear plug that has to be rolled between the fingers before inserting it into the ear. This hearing protection device has a NRR of 33.

Employee Compliance to Wearing Hearing PPE

In terms of the compliance level for wearing hearing PPE, the compliance level varies widely from first to second shift. The average compliance level for first shift is approximately 50%, while the average compliance level for second shift employees is approximately 18%. It seems that employees on the first shift are more likely to wear hearing protection since there are more people making noises, while there are fewer

people working on the second shift and thus the noise levels are somewhat reduced.

Another possible reason for the increased use of hearing protection during the first shift is that the safety support individual works during such time.

Training

The training component of the hearing conservation program is provided by a mobile medical unit and involves watching a brief video about the function of the ear, effects of loud noises on the delicate ear, purpose of hearing protection devices, and finally, what the audiometric testing involves. Company XYZ then does not supplement this training as this is perceived to be a cost effective method of training and the contractor program meets and/or exceeds OSHA regulations and standard.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of this chapter is to discuss the results presented in chapter IV and to assert reasonable conclusions regarding the data. In addition, this chapter will provide recommendations and conclude with the errors the researcher recognized during this research process.

Purpose Statement

The purpose of this study was to assess the hearing conservation practices of Company XYZ. The primary goals of this research was to gather four different types of information, the current noise levels that exist within the production areas of Company XYZ, the extent that the current PPE is used by the employees, the extent that employees are complying with the current hearing conservation policy, and the extent that employees have been trained on the proper use of hearing protection devices. This information was gathered through the use of noise dosimeters with data logging capability to record sound levels over a period of time. The noise dosimeters were set up in various locations within the production facility to record sound levels at different areas of the facility. In addition, various forms of hearing being utilized by Company XYZ were analyzed to determine the adequacy of protecting employees from the noise levels. Casual observations were made to determine the level of compliance in terms of employees wearing hearing protection devices. Finally, an assessment was made on the adequacy of training that employees have received in the past.

Conclusion

The data acquired through this research process indicates that the noise generated through the work activities is borderline with the OSHA regulations. While actual comparisons cannot be made since the sampling time was not for the entire shift or eight hours, conclusions can be drawn from this data set. The data indicates that average noise levels seem to be acceptable, however, the impact noises can be moderate and even peak at very high levels. These impact noises are the sounds that have the greatest potential to damage the ear, thus causing hearing loss.

After careful analysis of the types of hearing-based PPE being used, the researcher is confident that the hearing protection devices that Company XYZ utilizes are adequate in protecting the hearing of their employees (when used properly all the time). However, it should be noted that the hearing protection compliance level is poor on first shift and much lower on second shift. It is the belief of this researcher that if the compliance levels do not improve, it is likely that employees will continue to experience hearing threshold shifts.

The video-based training provided by the contractor appears to be adequate in meeting the OSHA standards. There are merits to having classroom training provided by a live and knowledgeable person and there are merits with video training as well. In both cases, employees are provided with audio and visual components. It appears that training in person allows for more flexible interactions and questions and answers while a video-based training tend to make employees passive listeners. In addition, this video-based training does not allow for hands-on practice of the hearing protection devices.

Recommendations for Improvement

There are several recommendations that the researcher would like to share with Company XYZ. These are as follows:

- It is recommended that another complete noise level analysis be performed which entails personal monitoring for the duration of the work shift. The entire shift monitoring will provide an eight-hour time weighted averages plus an additional two hours of monitoring for the extended time worked beyond eight hours. Personal monitoring for the entire shift will provide the best representation of the noise employees are exposed to and allow for better comparisons to be made against the regulations.
- Due to poor compliance with wearing hearing PPE, the researcher strongly recommends that hearing protective devices be worn at all times by employees while they are engaged in work activities in the metal fabrication areas.
- Employees need to be held accountable and take ownership of wearing hearing protection devices in order to effectively protect their hearing. This is a critical enforcement issue in which management and first-line supervisors need to take disciplinary actions against employees who are not wearing their hearing protection devices.
- Since the training is video-based and may not display the exact types of hearing protection devices that Company XYZ offers, it is highly suggested that in-house training be offered which would permit the employees to have hands-on practice with inserting the hearing protection devices into the ear.

- Finally, and most importantly, it is recommended that Company XYZ encourage and motivate its employees to be active participants in this program as their participation is critical to the success of the program and the company as a whole. It should be continuously emphasized that this program was implemented to help preserve their hearing.

Summary

It is believed that following the results as well as the recommendations of this study will assist to reduce incidences of significant hearing threshold shifts for Company XYZ. Furthermore, when workers use the hearing protection devices properly, they will experience less fatigue and irritability from the excessive impulse noise and all other sound levels generated in their work environment. The researcher also highly advocates not exposing oneself to excessive noise levels outside of the workplace. When one takes part in non-work activities which involve excessive sounds, the noise levels are just as damaging to the ear. Therefore, the researcher recommends that all workers wear their hearing PPE properly to protect their hearing on and off the job.

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