

# Noise Induced Hearing Loss Accountability on Jobsites within the Construction Industry

**Joseph O. Lamphere**

California Polytechnic State University  
San Luis Obispo, CA

Noise induced hearing loss is a major issue on jobsites within the construction industry. Every day workers are exposed to hazardous levels of noise, but they are not being properly managed to mitigate this issue. Workers have misconceptions about the topic, but more surprisingly are sometimes indifferent to the effects; believing hearing loss is inevitable, or it can be cured with a hearing aide. Construction has inherent dangers that workers have to deal with every day. Hearing loss might not be on the top of their lists, but the effects are permanent, and they cannot be cured with a hearing aide. This paper will discuss the research on noise induced hearing loss and its consequences, how this information is being received by construction industry members, and a solution for this issue. It will be evident that construction industry members are not taking hearing protection seriously, and the solution industry members being held accountable.

**Key Words:** Noise Induced Hearing Loss, Accountability, Hazardous Levels of Noise, Misconceptions

## Introduction

The construction industry is fraught with hazards, but a key danger that is often overlooked on many jobsites is something that can be found anywhere, sound. It is intriguing that something so prevalent within the construction industry is looked at with such indifference by its members. Noise has always been an issue, and always will be, but many people are working towards its mitigation. The problem is, their findings are still not being implemented on jobsites. At the heart of this issue is accountability. If more people within the construction industry were held accountable for noise induced hearing loss, then change will take place.

The National Institute for Occupational Safety and Health (NIOSH) has done extensive research on noise and hearing protection because, "In the Occupational Safety and Health Act of 1970, NIOSH is charged with recommending occupational safety and health standards and describing exposure concentrations that are safe for various periods of employment—including but not limited to concentrations at which no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience" (NIOSH, 1998). The work done by NIOSH laid the groundwork for all hearing protection studies that followed, because their discoveries led to the basics of noise exposure. For example, the recommended exposure limit (REL) for workers during an eight hour day should not exceed 85-dBA, no worker should be exposed to levels greater than 140-dBA, and employers need to enact hearing loss prevention programs (HLPP). Without the work done by NIOSH, the understanding of noise within the workplace, or how to prevent hearing loss as a consequence of that noise, would be abysmal.

The problem is that NIOSH's findings are not always implemented on jobsites. It is known that, "Around 18% of construction workers are exposed to levels above 85-dBA every day" (NIOSH, 1998). But, those numbers have not gone down. In fact, other studies show that 18% is conservative. This is substantiated by the fact that "...hearing loss is the second most reported occupational illness for American workers" (Stephenson, 2001). So, workers are being exposed to unhealthy amounts of noise, and it is being reported. Then, the question is, why is the construction industry not doing anything about it? The unfortunate answer is, they are, but not as much as they should. Most employer's solution for hearing protection is providing their workers with cheap earplugs. Employers then say the issue of hearing protection is in workers hands, and if hearing loss arises it is because they are not wearing the protection provided. Not wearing hearing protection devices (HPD) is a problem, with workers most commonly

reporting, "...discomfort, interference with hearing speech and warning signals, and the belief that workers have no control over an inevitable process that culminates in hearing loss" (NIOSH, 1998). However, blaming the workers is the easy route. The problem is initiated by the company's lack of interest. Workers believe that hearing loss is inevitable even though the research proves it is avoidable. Otherwise, why would the research continue to be conducted? Companies need to set up their employees for success. This starts with them taking interest in the issue, and putting in serious investment towards its solutions. Hearing loss is not a non-issue, and it is time construction companies stopped treating it as such.

## General Background

In order to have a clear understanding of the concepts discussed in this paper it is important to be knowledgeable of the science behind noise, hearing loss, and hearing protection.

### *Physics of Sound*

The way that noise is measured is in decibels (dB), which are units of sound pressure. The loudness of a noise is subjective for humans, so it is weighted on a scale that depends on sound pressure as well as its frequency (Hz). The most commonly used is the A weighting scale (dBA) because it encompasses sound levels that can harm the human ear (OSHA Technical Manual, 2013). The way that the A weighting scale is depicted on a graph is shown in Figure 1. It also shows the hearing threshold at 0 dB, climbing all the way to the threshold of pain at 140 dB. This is not the range of all sound, but the range of human hearing.

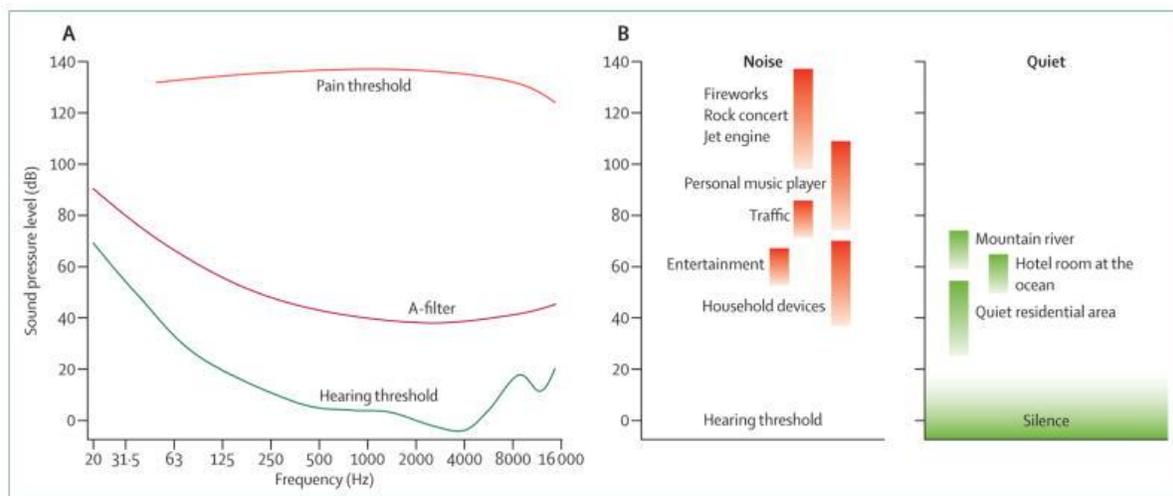


Figure 1: Sound Pressure Levels  
Source: (Basner, 2013)

In discussions of sound it is most common to talk in terms of decibels, but when it comes to hearing loss the more important factor is frequency. "Because of the shape of the external ear canal and other factors, the human's sensitivity to sound is greatest between 1000 and 5000 Hz" (May, 2000). The range of frequencies a person can detect depends on their age and level of hearing loss, but for normal human speech the range is between 500 Hz to 4,000 Hz. An early indicator someone is developing hearing loss is that they can no longer detect frequencies between 3,000 Hz and 4,000 Hz (OSHA Technical Manual, 2013).

### *Noise Induced Hearing Loss*

When a person is exposed to noise levels of 85 dBA for over eight hours, 95 dBA for over an hour, or anything over 100 dBA for any time at all, this is when noise induced hearing loss (NIHL) can occur (NIOSH, 1998). This is a

problem within the construction industry because, according to Noah Seixas and Rick Neitzel, researchers for The University of Washington, “Construction workers were exposed over 85 dBA in about 70% of work shifts using the NIOSH exposure standard. Even “quiet” trades like electricians had a substantial percentage of measured workshifts that exceeded 85 dBA” (Seixas & Neitzel, 2004). The research shows that most construction workers are exposed to dangerous levels of noise, not every once in a while, but every day. Even the standards set by NIOSH can result in NIHL because exposures at the recommended exposure limit (REL) of 85 dBA over a 40 year lifetime still has an 8% chance of developing NIHL. Also, OSHA’s standards for a workers permissible exposure limit (PEL) at 90 dBA has a 25% excess risk for hearing loss (NIOSH, 1998). Even if workers follow the standards set by the agencies in charge of looking after their health, hearing loss can still develop.

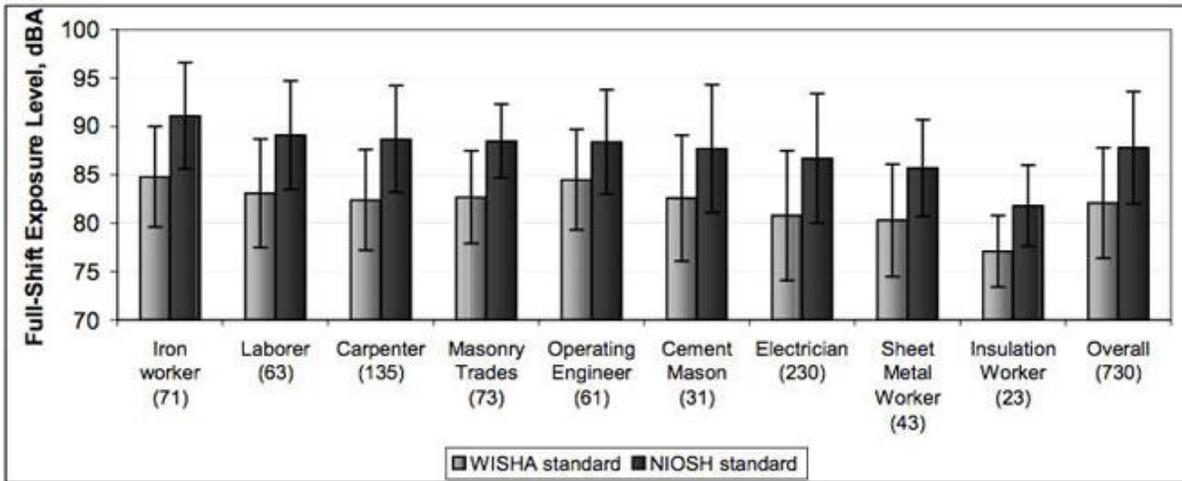


Figure 2: Full-shift Average Exposure Levels by Trade

Source: (Seixas & Neitzel, 2004)

A common misconception is believing that certain trades, as well as management positions, have such a small risk of hearing loss that they do not have to worry about it. This is false, as seen in Figure 2, various trades have a wide range of exposures with standard deviations of up to 5 dBA from their means. Certain trades have lower levels so they do have less of a percentage of risk, but gambling on percentages is foolish when there is a significant chance of permanent hearing loss. This is true for those working in jobsite trailers as well, because NIHL among operations engineers have rates of up to 30%. Also, those rates go up to 50% for laborers, where many managers start their careers (Seixas, 2012).

In fact, the start of ones career within the construction industry is a very crucial time when it comes to hearing loss. Young workers can be uninformed of the dangers of hearing loss, and since their hearing is fine they tend not to think about something without immediate consequences. However, they should be concerned because according to Seixas, “Hearing loss rises rapidly over the first 10 years of exposure, slowly leveling towards an asymptotic level of damage, depending on the noise intensity” (Seixas, 2012). Hearing loss is dangerous because workers may not notice its effects until the damage is done. Even if workers start to notice the effects, the misconceptions around hearing losses inevitability deters them from lessening their loss. But, hearing loss should be a concern of young workers, as NIOSH researcher Carol Stephenson states, “studies found that 25 year-old carpenters frequently have the hearing of a non-noise exposed worker at age 50” (Stephenson, 2001). NIHL needs to be taken more seriously by members of the construction industry, because its consequences are not something that anyone, especially a person in their twenties, should have to deal with.

### *Consequences of NIHL*

Persuading construction workers to worry about NIHL can be difficult because many believe that either they will not see the effects until later in life, or that the effects are not that bad. Worse hearing may seem negligible when any day on a site someone could lose a limb, be seriously burned, or even die. Nevertheless, hearing loss has serious consequences that can effect both a workers safety at work, as well as their happiness in their personal life.

Observational and experimental studies from Doctor Mathias Basner have shown, “noise exposure leads to annoyance, disturbs sleep and causes daytime sleepiness, increases the occurrence of hypertension and cardiovascular disease, and impairs cognitive performance” (Basner, 2013). These issues could result in endangering that individual, those around them, or those they are in charge of. As for a worker's personal life, as stated by Marisol Concha-Barrientos from the World Health Organization, “The consequences of NIHL include: social isolation, impaired communication with coworkers and family, decreased ability to monitor the work environment (warning signals, equipment sounds), increased injuries from impaired communication and isolation, anxiety, irritability, decreased self-esteem, lost productivity, expenses for workers’ compensation and hearing aids” (Concha-Barrientos, 2004). There is a plethora of ramifications resulting from hearing loss that would distress anyone, and should be on the minds of everyone within the construction industry.

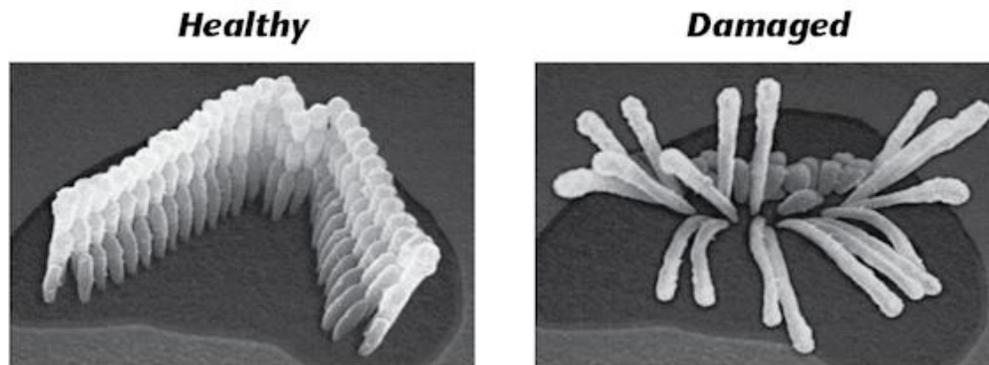


Figure 3: Damaged Hair Cells after Repeated Exposure to Loud Noise  
Source: (Sound Life, 2018)

Possibly the most unsettling consequence of NIHL is its permanence. This has to do with the biology of the human ear in the cochlea, and more specifically the Organ of Corti, which is located in the inner ear, and are responsible for hearing. Figure 3 shows hair cells, which are a part of the Organ of Corti, and how they respond to dangerous levels of noise. Either from specific instances of trauma, or exposure to harmful levels over time, the hair cells become damaged. Different parts of the cochlea are responsible for discerning sounds at different frequencies. As stated in the Physics of Sound section, the higher frequencies are the first to be damaged, followed by the lower ones which detect speech.

The problem for NIHL stems from the fact that, “Auditory sensory cells in the cochlea cannot regenerate in mammals, no remission can occur; prevention of noise-induced hearing loss is the only option to preserve hearing” (Basner, 2013). Once these cells are damaged, hearing at those levels are gone. These facts become more frustrating when researchers like Carol Stephenson find, “Although there is an acknowledgment that working on a noisy construction site will result in some work-related hearing loss, workers believe that using hearing aids will restore hearing in the same way that glasses can restore vision” (Stephenson, 2001). This is problematic because hearing aids do not truly help with cochlea issues, they only make sound louder. A hearing aid will not allow a person with damaged cochlea hair cells hear at those damaged frequencies. The best way to prevent this from happening is to be knowledgeable of hearing loss, and have the right hearing protection devices (HPD).

### *Hearing Protection Devices*

Ear plugs are not a recent technology. Even when Odysseus and his crew needed protection from the Sirens song they fashioned them out of beeswax. Unfortunately, for many jobsites the extent of their hearing protection plan is ear plugs. Thankfully, today, there are a wide variety of HPD’s that were invented more recently than the 12th century B.C.E. As stated by NIOSH, the most effective way to prevent NIHL is to either remove the worker from the hazardous noise, or the hazardous noise from the worker (NIOSH, 1998). But, that is not always possible. Working in construction means there is going to be noise, and having an efficient jobsite means the work needs to happen. The noise just needs to be prevented. However, problems arise when work is continued near the hazardous noise, and workers are not wearing the proper hearing protection. Studies by Seixas and Neitzel found,

“Construction workers wore hearing protection less than 20% of the time, on average, when exposure levels were over 85 dBA. Overall, less than one in five overexposed shifts was brought below 85 dBA by HPDs” (Seixas & Neitzel, 2004). Jobsites across the country have workers wearing personal protective equipment (PPE). Workers know on a jobsite hard hats, work boots, reflective vests, and protective glasses are required, but when it comes to hearing protection their standards drop.

The most common complaints by workers for not wearing hearing protection include: poor fit, discomfort, and the loss of the ability to hear direction and warning signals. However, these issues can be easily diminished with proper training and selection of HPD’s. Poor fit and discomfort can be resolved simply by selecting the right HPD for the task at hand. In some cases ear plugs are a quick and easy solution, but there are a wide variety of HPD’s that are more comfortable, and are better at providing protection from hazardous noises. Not being able to hear someone can be a huge issue on a jobsite where communication is integral. Even so, NIHL effects a person’s ability to hear just as much as an HPD, but only one of them is permanent. Thankfully, studies done by Colleen Le Prell and Odile Clavier at the University of Texas have found, “The availability of active electronic HPDs has allowed better signal detection and identification abilities despite the use of HPDs” (Le Prell & Clavier, 2017). Regular HPD’s like ear plugs and ear muffs make it hard to discern certain frequencies of speech. Frequencies are received by the ear as tone, so some words can become muffled and indiscernible. But, with the use of active electronic HPD’s they can cut out the hazardous noise while still allowing someone to have a conversation.

Furthermore, there are many factors that go into how someone hears, for example, “The degree to which one sound masks another and the resulting masked threshold depend on the physical characteristics of the sounds (levels, spectra, periods, etc.), the hearing threshold of the listener, the etiology of the listener's hearing loss (if present), the attenuation characteristics of the hearing protector (if used), and the manner in which sound is processed by the inner ear and the brain” (Le Prell & Clavier, 2017). This is why preventing NIHL, and using HPD’s early in one’s career, is imperative. Studies have shown that signal detection while wearing HPD’s becomes better over time. Workers need to have HPD’s integrated into their regular PPE practices. That way hearing loss is minimized, and speech recognition becomes easier.

## **Methodology**

The process of researching noise, NIHL and its consequences, HPD’s, and hearing protection plans was fundamental to understanding noise on jobsites. Once the basics had been established the next step was to see how this knowledge was being applied in the industry. To do this, interviews with — project manager (PM), superintendent, and project engineer (PE) — were conducted. The interview questions that helped direct the conversations were as follows:

1. What would you do if you saw someone doing their task in an area with hazardous noise levels?
2. What kind of hearing protection devices would you provide for them?
3. What would you do if someone came to you asking about what they should do if they are experiencing hearing loss?
4. When was the last time you implemented one of these practices?
5. How often do you implement these practices?
6. How often are the sound levels tested on your jobsite?

Once the research had been deciphered and the interviews were conducted the information collected could then be extrapolated, and formed into a coherent solution. As a base, NIOSH’s Hearing Loss Prevention Program was used (NIOSH, 1998):

1. Initial and annual audits of procedures.
2. Assessment of noise exposures.
3. Engineering or administrative control of noise exposures.
4. Audiometric evaluation and monitoring of workers’ hearing.
5. Use of hearing protectors for exposures equal to or greater than 85 dBA, regardless of exposure duration.
6. Education and motivation of workers.

7. Record keeping.
8. Program evaluation for effectiveness.

## **Results and Discussion**

The ordering of the interview questions had the intention of flushing out the underlying issues with how hearing protection practices are implemented on jobsites. The first three were standard questions about noise issues on jobsites, and, unsurprisingly, they got standard answers. Anyone who works in the construction industry, especially a PM, PE, or superintendent, is going to have OSHA training, and be knowledgeable of hazardous noise, HPD's, and NIHL prevention. Some were even experiencing some symptoms of NIHL themselves, and knew others with similar experience.

Regardless, the interviewees used their prior knowledge, and came up with answers for what they would do in each situation. Remove the worker from the noise or provide them with hearing protection. Depending on the noise they would provide ear plugs or ear muffs. Talk to the safety manager who will provide steps for hearing loss mitigation. This set up the baseline for what each individual would do in these situations. The following three questions ask when, and how often, they actually implement these practices. This is where interviewees had more trouble answering the questions. Responses varied from just this week, to never. Honestly, this was not surprising. The responses proved the underlying assumption that managers are not invested in hearing protection, which in turn, correlates to the workers lack of interest.

For the PM and PE's, who spend most of their time in the office, it was most difficult for them to think of times when they actually implemented these hearing protection practices. From their previous answers it was clear they knew what to do, but when it came time to implement it in the field, usually they would rely on someone else. That person was usually the superintendent. Discussing implementation with the superintendent had the best results, because he spends the most time in the field, and with the workers. The superintendent was knowledgeable about noise, provided hearing protection to his workers, and conducted toolbox talks on the dangers of NIHL. The interesting part was when the superintendent's own hearing protection practices were discussed. For years he worked as a welder, and admitted that he did not always wear hearing protection. Welding can produce sound levels above 100 dBA which can be harmful for anything over 15 minutes. He said he was experiencing hearing loss, and rarely wears hearing protection, because he believes his hearing loss could not get much worse. This is problematic because someone who does not believe in, or follow, the practices they are teaching, will have a hard time convincing someone else to listen.

NIHL is a major issue within the construction industry, the research is undeniable proof of that. It is plausible that the research alone would be enough to move industry members towards action. However, this is not the case, and it is not due to ignorance. Almost everyone within the construction industry is required to go through OSHA 10 training at the minimum. They know the statistics, consequences, and prevention strategies for NIHL, but somehow the message is not getting through. The results from the interview questions are proof that NIHL, and hearing protection practices, are not being taken seriously on jobsites.

The solution to this issue is a hearing loss prevention program that is effective, and holds people accountable. The eight part hearing loss prevention program created by NIOSH is excellent, but only in theory. The main issue with the plan is accountability. If this plan was being followed by every jobsite in the nation there would be a sharp decline in NIHL, but that is not the case. Therefore, it is reasonable to assume that their plan is not being followed. However, if companies were held accountable for instances of NIHL in their workers, this would change.

The proposal is to give NIOSH the ability to fine construction companies whose workers have developed a hearing loss disability as a consequence of their work at said company. NIOSH already conducts audits, but they cannot audit every job, or help every worker. But, if the basis of their fines come from workers compensation reports, they would not have to. Instead of tediously looking at every jobsite to see if their practices are up to standard, they could use a top-down approach, fining the companies with an above average level of hearing loss workers compensation reports. According to Basner, "Noise-induced hearing is the most common occupational disease in the USA: about 22 million US workers are exposed to hazardous noise levels at work, and, annually, an estimated US\$242 million is

spent on compensation for hearing loss disability” (Basner, 2013). As it stands now, companies are fine with paying workers compensation, and doing nothing about changing their practices. With a new fine on top of their workers compensation payments this holds those companies accountable, and incentives' them to change their ways.

With the companies on board, there will be a domino effect of accountability being placed on different levels of management all the way to the laborers. Companies will place greater investment into HPD's. Where once cheap earplugs were provided, jobsites will have a selection of active electronic HPD's that can be used in a wide variety of situations. Audiometric evaluations of all employees will become standard to ensure cases of NIHL are caught early, tracked, and treated. Employees will go to required training sessions where concepts discussed in the background section of this paper about NIHL will be taught, and the misconceptions around it will be debunked.

## Conclusion

In summation of the countless studies conducted by doctors, agencies, and professionals; the testimonies by professionals within the construction industry, and the conclusions drawn from their interviews. It has become clear that noise induced hearing loss is a major issue within the construction industry. Despite that, it is not taken seriously by the members it is affecting. The research is clear that workers are being affected, but they are either misinformed on NIHL, indifferent to its consequences, or are not being given the tools to properly alleviate it. Management is knowledgeable of the topic, but they rarely apply their knowledge in the field. Construction companies are paying workers compensation for hearing loss disability, but they are unwilling to change their practices to reduce these claims. Everyone involved knows of the issue, and how it could be resolved, but there is not enough accountability for change to take place. Therefore, that is the solution. Top-down accountability, where construction companies are incentivized to enact change within their company. Once this change is made, and accountability is placed on the entire industry, then NIHL will become a rarity, and it will stop impacting the lives of those within the industry.

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