



# SPECTRUM

a publication of the National Hearing Conservation Association

NOVEMBER 2024

VOLUME 41 (ISSUE 3)

## NHCA Annual Conference News

by Amy Blank  
*Conference Program Chair*

The excitement for our 49th Annual Conference is building! Thank YOU for your abstract submissions; we received over sixty submissions! The program task force volunteer reviewers are busy reviewing, while Dr. John “Andy” Merkley, the Director of Education, and his team are building our 2025 program.

We are proud to announce three full-day workshop offerings in 2025. Dr. Richard Danielson is leading “Hearing Conservation Program Basics, Fundamentals, and More” with a line up of outstanding co-presenters. We will offer a “Hearing Protector Fit Test Workshop” led by industry experts which will include presentations in the morning and hands-on demonstrations of fit testing equipment in the afternoon. Finally, “Updates in Music Audiology” will feature some of the most active and prolific speakers, clinicians, and researchers in the field who will share updates to best practices and technology/procedure updates pertinent to anyone interested in this population.

In the last Spectrum edition, we announced that Dr. Rick Neitzel, from the University of Michigan School of Public Health, will give our 2025 Keynote Presentation and James Jerome, well-known and long-time NHCA member, will present our 2025 Gasaway Lecture. As we meet in historic Charleston, established in 1670 as a colonial seaport, we have an exciting Luncheon Speaker from the National Marine Mammal Foundation. Dr. Dorian Houser, the Director of Conservation Biology, will share insights on anthropogenic ocean noise and its effect on marine mammal hearing. Did you ever wonder how ocean noise sources (e.g., sonar, seismic surveys, shipping) impact marine mammals' ability to hear, allowing them to forage, avoid predators, and navigate? Did you know the Marine Mammal Protection Act weighs auditory functions to assess potential impacts to marine mammals? Learn about marine noise

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*Spectrum* is a publication of the National Hearing Conservation Association (NHCA), P.O. Box 3406, Englewood, Colorado 80155, which is published 3 times yearly around May, August, and October. A *Spectrum* Supplement is provided prior to each year's Annual NHCA Conference. The information contained herein is designed to promote action and discussion among members. The information has been obtained from sources believed reliable, and the editors have exercised reasonable care to assure its accuracy. However, the NHCA does not guarantee that the contents of this publication are correct and statements published do not necessarily reflect the opinion or official position of the NHCA.

*Spectrum* is available without charge to NHCA members in all categories. Anyone interested in publishing in *Spectrum* should contact Ashley Montoya at the NHCA office.

*NHCA provides leadership, expertise, and education on hearing loss prevention strategies and services to the broader professional community and empowers and supports members through networking and advocacy.*



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# presidential pEARspective

## Moving NHCA Forward

by Elizabeth Masterson  
NHCA President



Dear NHCA Family,

By the time you read this, NHCA will have an updated **strategic plan**. Your Executive Council (EC) met in the Summer, along with Leading Associations, to review our current strategic plan and decide what should stay, what should be modified and what should be deep-sixed to best position NHCA for success in the next few years. Your EC focused the new plan to three main goals:

### **Goal # 1 Enhance Financial Security:**

Establish and execute a comprehensive financial management plan, including a balanced budget, identifying and leveraging sustainable income streams, and developing a sound investment plan.

### **Goal # 2 Membership Growth and Value:**

Foster a multidisciplinary member base and enhance membership value.

### **Goal # 3 Shape the Future of Hearing Loss Prevention:**

Shape the future of hearing loss prevention through expertise, collaboration, and best practices.

Goal # 1 makes the other two goals possible. Times have changed and costs have increased considerably. Your EC wants to ensure that not only is NHCA here

for the long haul, but that our association is nimble and capable of confronting any financial challenges moving forward without losing momentum for our important work and member initiatives. Goal # 2 allows us to better support our membership and also greatly increase our impact on the field (Goal # 3). While NHCA is an incredible place to build lifelong friendships and collaborations, we are here to better the world of hearing and improve the quality of life for others. We will continue to do this by creating and promoting best practices, driving standard development, developing educational resources, collaborating, and engaging in other opportunities to influence (for good! 😊). The entire strategic plan is posted [here](#).

**What can NHCA members do to help us achieve these goals?** Volunteer to serve on the Executive Council, task forces and other activities. We need more great minds to play a part in NHCA's future. Make sure everyone you work with and those you meet know about NHCA. You are NHCA's best ambassadors. Come to conference, our new Summit, network and take advantage of every member benefit. Finally, continue to contribute to our field in your own way. It's why you are here and why NHCA is so special!

# NHCA Annual Conference News

*Continued from Page 1*

impacts, measurement techniques, and more during this engaging Luncheon talk.

Registration for the 49th NHCA Annual Conference opened on October 15, 2024. Register early to take advantage of early bird pricing! Consider joining us before the annual conference for a few free pre-conference activities! The first is the Sponsor Ignite Session scheduled for January 7, 2025, at 1pm EST. This is an excellent opportunity to engage with our valued sponsors before the conference and get a “sneak peek” of their exciting new products and services. Additionally, we will hold a Virtual Round Table event on January 21, 2025, at 4pm EST. In a casual environment, meet and discuss highlighted conference topics, moderated by experts in the field.

The NHCA conference provides the best opportunity to meet like-minded hearing conservationists and

engage one-on-one. Whether you are an experienced hearing health professional or a first-time attendee, NHCA is the conference where you can develop collaborative relationships. Consider inviting colleagues, students, and others who would find value in the NHCA conference and its mission. A personal invitation for new attendees to OUR conference is the most powerful tool to involve prospective members and grow OUR organization.

Finally, would you like to join our team? We have a full range of volunteer opportunities to increase member engagement in both preparing for, and participating in, the conference. If you are interested in joining our conference volunteer pool or have suggestions for the conference, drop an email to [nhcaoffice@hearingconservation.org](mailto:nhcaoffice@hearingconservation.org). We are looking forward to the 49th NHCA Annual Conference, February 6-8, 2025, in Charleston, SC.




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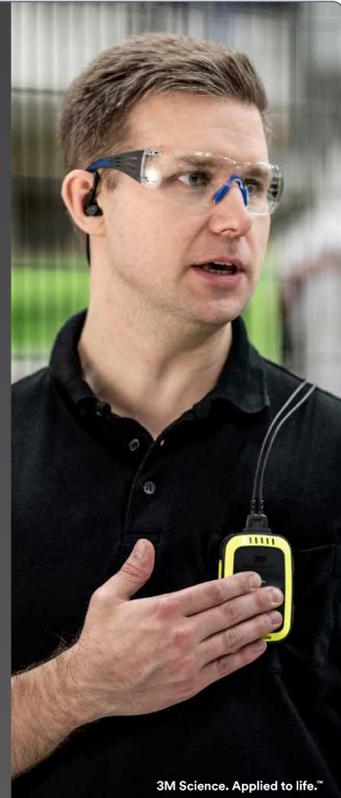
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# Taking the Bang out of Firearm Noise

William J. Murphy, Stephen M. Tasko, and Gregory A. Flamme  
 Stephenson and Stephenson, Research and Consulting, LLC

Firearm noise exposure is regularly identified as a contributor to poorer hearing sensitivity in the population. A single discharge of a firearm can produce temporary and permanent hearing damage. Firearms have an immense range of energy which makes measurements of the noise challenging. The firearm peak noise levels exceed typical manufacturing occupational noise exposures by several orders of magnitude. Consequently, hearing conservation professionals need to understand the special considerations when making impulse noise measurements, assessment of the risks of exposure to firearm noise, and mitigation of firearm noise exposures (Stewart et al., 2017).

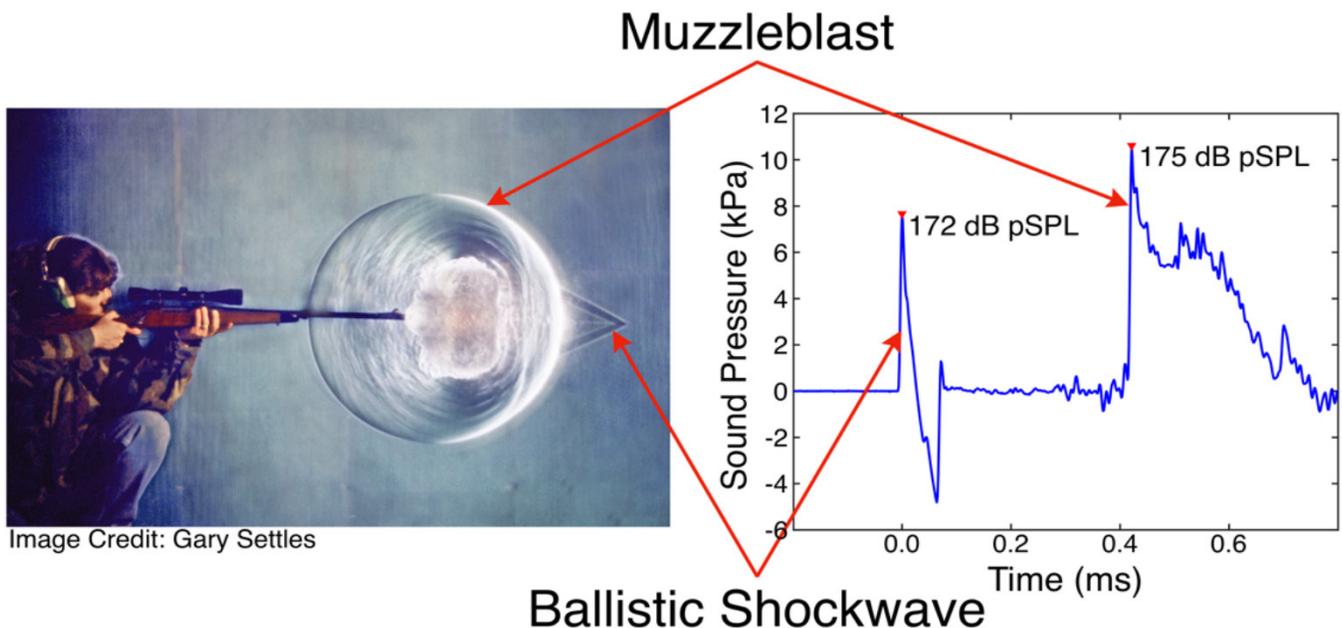
## Firearm Noise Components

Firearm noise has several distinct components depending upon the design: intense pressures are produced in the firearm chamber, and these pressures accelerate the projectile(s) through the barrel. If the projectiles reach supersonic speed, they will produce a

cone-shaped shock wave as the bullet travels through the air. If a firearm has a cylinder containing the chamber, such as revolver handguns, then the gap between the cylinder and the barrel provides an escape route for the pressurized gas. Semiautomatic and automatic firearms use the expanding gases produced by gunpowder combustion to eject the spent cartridge and load the next one into the chamber. After this work is done, the gas may be exhausted via a gas ejection port.

## Firearm Noise Propagation

When ammunition is discharged, solid propellant combusts to a much greater volume of heated gas, the pressure from which accelerates the bullet or other projectile(s) toward the muzzle. As the gas in the barrel escapes the end of the barrel, a spherically-expanding blast wave is produced (see Figure 1), with more energy radiated forward than backward along the barrel. Thus, the sound escaping the muzzle is more hazardous in front or to the side of the weapon.



**Figure 1.** Schleiren photograph of a rifle being fired with a supersonic round and the pressure waveform. As the supersonic bullet moves away from the spherically expanding muzzleblast, it forms a ballistic shockwave that is conical and which takes on a characteristic N shape (Flamme & Murphy, 2022).

For supersonic bullets, the ballistic shock wave is cone-shaped and propagates away from the trajectory of the bullet (see Figure 1), and combines with the blast wave in the region forward of the muzzle. In other words, the ballistic shock wave presents the greatest hearing hazard nearest the path traveled by the supersonic projectile. If the bullet's velocity is just above the speed of sound the intersection will be very near to the trajectory and as the bullet slows to subsonic speed, the ballistic shockwave will no longer be generated. It is crucial to understand that the ballistic shock wave is generated by the bullet, not by the expansion of the combustion of gunpowder. The ballistic shock wave characteristics are driven by the distance, speed and dimensions of the projectile (Flamme and Murphy, 2018). Downrange and near the projectile's trajectory, the ballistic wave will be more intense and arrive earlier than the blast wave.

The other components of firearm noise, (primer, cylinder gap, and gas ejection ports) are created by specific events within the firing process and have a definable location where they are generated. These events, particularly the primer and gas ejection, have amplitudes that can be 10 to 20 dB lower than the peak of the noise produced by the muzzle blast.

### Reflection, Refraction, Diffraction

Sound intensity decreases with increased distance from the source because it is spread across a larger area. The change in sound level as a function of distance can be expressed as

$$\Delta L = -20 \log_{10} \left( \frac{r_2}{r_1} \right)$$

where  $r_1$  and  $r_2$  are the distances. All other things equal, peak sound levels decrease by 6 decibels (dB) per doubling of distance (i.e., following the inverse square law). This formula does not account for any atmospheric effects such as sound absorption, turbulence, terrain or temperature (Driscoll, 2022a).

Sound waves can be transmitted, absorbed, reflected, refracted, and diffracted when they interact with gases, liquids, or solids. Refraction affects the propagation of sounds at long distances. As the density or temperature of medium changes, the speed of sound is altered and in turn causes the sound waves to propagate along a curved path. At night, noisy venues can be more easily heard at a distance because the cooler air bends the path of sound propagation towards

the ground. Sound barriers are designed to absorb sound and also to block the transmission to locations closest to the wall. For locations further away from the wall, the height and thickness of the wall affect the sound because it is diffracted around the edges. Acoustical engineers consider both refraction and diffraction effects when designing sound barrier walls to attenuate noise from industrial or community noise sources. Community planners need to consider how noise from firing ranges might impact the expanding residential areas.

For the purpose of hearing conservation, impulses that propagate in a direct line or are early reflections tend to have the highest amplitude and consequently the greatest risk of damaging the ear. The ground reflection of an impulse is almost unavoidable unless the ground between the source and the receiver is treated with absorptive materials. If walls or ceilings are near the source or receiver, such as an indoor shooting range, then reflections from those structures could also increase the hazard.

### Mitigation of Firearm noise

Firearm noise is described with sound pressure (Pascals) and sound pressure levels (dB SPL). The various damage risk criteria (DRCs) include metrics such as cochlear energy, exposure levels or auditory hazard units that are used to assess the risk of hearing damage and inform mitigation strategies (Brokaw et al., 2023). The change in sound level is often used to quantify the effect of hearing protection devices or noise treatments applied to the firearm or the environment.

### Hearing Protection

Every hearing conservation professional should know that hearing protection should be properly fitted and worn whenever a firearm is fired near the listener. Early studies of impulse noise identified that levels above about 140 dB peak sound pressure level (dB pSPL) present increased risk of noise induced hearing loss (Garinther and Hodges, 1972, Ward et al. 1968). Coles et al. (1968) proposed a DRC based on the peak level of an impulse and the A-duration and B-duration of the impulse. A-duration is the amount of time for the initial overpressure related to the gunshot. The B-duration considers the decay of the gunshot waveform to a tenth (-20 dB) of the initial peak pressure. The U.S. National Research Council Committee on Hearing Biomechanics and Bioacous-

tics proposed a DRC for the United States that later became MIL-STD 1474 (Ward et al. 1968, Garinther and Hodge, 1972). This military standard is intended for use in procurement decisions. The U.S. military does not currently have a medical standard for impulsive noise, but one has been proposed (Brokaw, et al. 2023). In MIL-STD 1474D (1997), the peak sound pressure level, the B-duration were necessary to estimate the allowable number of rounds that one could fire. Implicit in MIL-STD 1474D is an assumption that all persons exposed to peak levels greater than 140 dB will always wear hearing protection with at least 29 dB of peak attenuation. In cases where a single hearing protector would be insufficient, double protection ( earmuffs and earplugs) were presumed to reduce the peak by another 6.5 dB.

It is difficult to establish how much attenuation a person receives from a hearing protector. On one hand, the insertion of an object in the ear canal disturbs the resonance of the open ear canal, which is typically on the order of 12-15 dB at some frequencies. On the other hand, hearing protectors require proper insertion, fitting, and use. A poorly-inserted earplug does little or no good. An earmuff that allows air leaks is also compromised. It must also be recognized that some ears, heads, and necks are incompatible with some earplugs or earmuffs, so it is important to assess the attenuation of properly fitted hearing protection and to instruct the user about how to insert or don the hearing protector.

The American National Standard ANSI/ASA S12.42-2010 (R2020) describes how to assess the impulse peak insertion loss of hearing protectors using an acoustic test fixture. This method establishes the capability of the hearing protector when it is used properly on a person for whom it is suitable. The S12.42-2010 method measures just the change in the peak sound pressure level and does not account for the potential changes in attenuation due to the spectrum of the impulse. More energetic weapons can have more low frequency content. Murphy et al (2015) and Fackler et al (2017) showed how the spectra can affect the measurement and how the same hearing protector measured on the same fixture but with different sources can yield substantially different results. A more comprehensive analysis of impulse level dependent attenuation (ILDA) for hearing protection permits attenuation estimates for a variety of sources. The ANSI-ASA S12.42-2010 standard lacked a method to account for

the maximum limits of hearing protector attenuation due to bone/tissue conduction and other factors.

## Noise Treatments

Firearm noise treatments vary from simply building barriers that also prevent penetration of the bullets and ricochets, to designing baffles and barriers to absorb impulse noise specifically. Many firing ranges are designed to contain the bullets and stray shots by using poured concrete walls, armor plate and baffles above the firing lanes to deflect stray shots and contain them within the range.

Consider sound energy interacting with a surface. The direct and reflected energy can affect the ear. The amount of energy reflected by a surface depends greatly upon the surface's smoothness and porosity. If the wall is smooth and not porous (e.g. steel or poured cement walls), then you might expect a substantial fraction of the incident sound to be reflected. If the surface is not smooth and made of a porous material like cementitious fiber board or basalt rock wool, then sound energy can be transmitted into the wall and its energy absorbed by the material and the reflected portion can be diffused (Driscoll, 2022b). Layers of different materials in the construction of the wall provide changes in sound transmission path which can improve absorption characteristics.

Several factors need to be considered when selecting noise treatments: flammability, susceptibility to mold, and the ability to clean the surfaces to remove residue and unburnt propellant. Typical foam wedge panels may look nice after installation, but they tend to not be durable and are not cleaned easily. Solid rubber walls do not provide much sound absorption. For outdoor firing ranges, the propagation of sound into neighboring areas can be a community noise problem. Enclosed shooting stalls can be helpful, but may increase the exposures of the people in those stalls. One must also note that supersonic rounds will create ballistic shock waves that are more difficult to control.

## Firearm Suppressors

The best metric used to describe the suppression is a topic of debate. Suppressors, which can also be called "silencers" in lay terminology, are mufflers that reduce firearm blast noise levels. Over a century ago, the first firearm suppressors were invented and patented (Maxim, 1909). Early suppressors consisted of a can with baffles that "...dissipate their energy by

being given a rotary or whirling movement in a suitable chamber...". A popular approach to baffle design consists of ported concentric rings that fit inside the suppressor's shell. The ports connect the successive chambers formed by the rings and serve to dissipate the blast energy. Complex baffle designs can be optimized by applying fluid mechanics analysis methods to maximize the noise reduction.

The NATO AEP-4875 (2015) standard is specifically intended to provide "a testing protocol to accurately measure the far-field acoustic characteristics of a suppressor." This method is designed to exclude reflections and the ballistic wave, thus increasing the purity of the assessment at the cost of generalizability to typical use. In order to capture just the blast portion of the impulse and minimize energy from reflective surfaces, the shooter fires from at least 4 meters above the ground and the microphones are positioned 5 meters from the muzzle with an angular spacing of 25° increments from 180° behind the shooter to 5° off the direction of fire. The angular dependence of the blast noise around the muzzle is measured with multiple microphones. The sound exposure level,  $L_{SEL}$ , is used to describe the levels of both the suppressed and unsuppressed shots.

MIL-STD 1474D has been used to describe firearm noise for both the suppressed and unsuppressed conditions. As mentioned above, the peak level and the B-duration are measured with a microphone. Two common microphone locations are 100-200 cm to the side of the muzzle and 15 cm from the operator's ears. The position to the side is not representative of the levels at the shooter's ears and can overestimate the noise reduction at the ear (Murphy et al. 2018a).

The Department of Defense MIL-STD 1474E Design Criteria Standard Noise Limits (2015) "specifies the maximum permissible noise levels produced by military systems and the test requirements for measuring these levels." Noise should be sampled at the location of personnel operating the equipment. If the operator is present, microphones should be located 15 cm from the operator's ear on the side of the highest exposure (or at the center of the head when the operator is not present). When applied to firearm suppressors, the microphone(s) would need to be located near the shooter's ear. For an unsuppressed rifle, the left ear typically receives the higher exposure. Depending upon the firearm design (bolt-action vs. semiautomatic) the right ear may receive a higher noise ex-

posure. As well, the microphone positions will shift slightly depending upon the shooter, the length of the firearm and suppressor and the manner in which the firearm is held relative to the shooter's body.

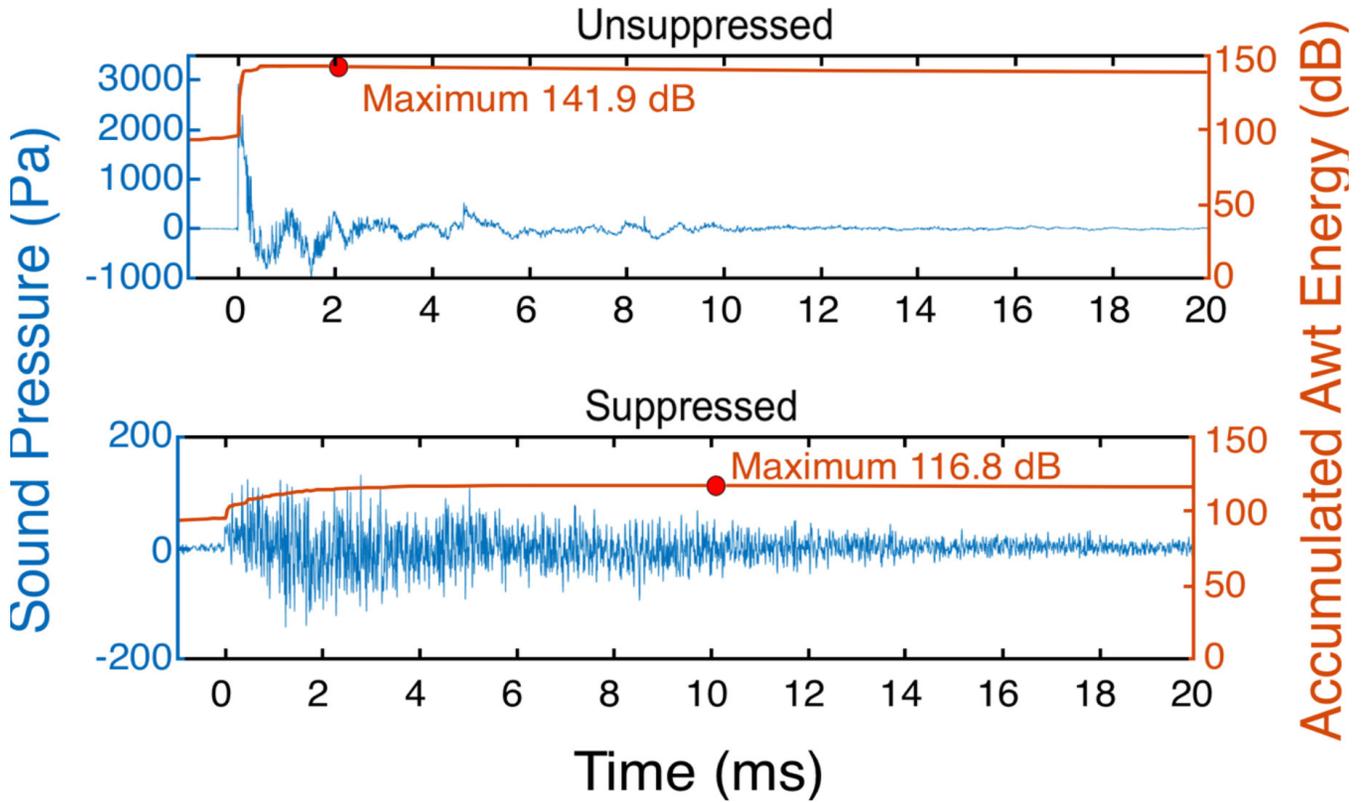
In the MIL-STD 1474D, the peak level was integral to the assessment of a firearm's exposure level. Firearm suppressor manufacturers tend to report the suppressed peak level because levels below 140 dB were deemed "hearing safe." That is, hearing protection was not required. Peak levels present challenges to accurate measurement and estimation of potential hazard to hearing. In MIL-STD 1474E, the equivalent A-weighted energy over a 100 ms interval,  $L_{IAeq,100ms}$ , is one of the metrics used to evaluate exposures. The  $L_{IAeq,100ms}$  includes a correction for the A-duration of the initial overpressure of an impulse that has not yet been validated.

To facilitate a comparison with hearing protection, firearm suppressor noise reduction can be expressed as a change in level (e.g., peak level,  $\Delta L_{Peak}$ ; sound exposure level,  $\Delta L_{SEL}$ ; or equivalent A-weighted energy 100 ms,  $L_{IAeq,100ms}$ ). Brokaw et al. (2023) reported that an equivalent A-weighted energy level would be a leading candidate DRC for use as a military health standard.

Murphy et al. (2018b) investigated the variability of suppressor measurements at 3 m from the muzzle for a range of firearms of different calibers, bullet velocity, and angles around the muzzle. The measurements at the left ear of the shooter exhibited the highest correlations across conditions with a position at 3 m from the muzzle and 225° from the line of fire (Murphy et al., 2018b). Peak reduction between the unsuppressed and suppressed conditions was investigated and found that the peak reduction overestimated the change in A-weighted equivalent 8-hour level (Murphy et al. 2018a). While the timing of the peak of an unsuppressed impulse is typically the maximum of the muzzleblast, the peak of a suppressed waveform can vary substantially in time and amplitude as can be seen in Figure 2 in the upper and lower panels with the blue trace.

Flamme et al. (2023) developed an approach to measure the accumulated A-weighted energy of the impulse waveforms.

$$L_{A,eq,T} = 10 \log_{10} \left( \frac{1}{T} \sum_{i=1}^n \frac{p_A^2(t_i)}{p_0^2} \Delta t \right)$$



**Figure 2.** Unsuppressed and suppressed sound pressure traces (blue lines) and the accumulated A-weighted energy as a function of time. The suppressed waveform does not provide a definitive location of the maximum sound pressure. The accumulated A-weighted energy initially increases rapidly and grows to a maximum level after which it decays gradually as more of the quiet following the impulse is included.

where

$L_{A,eq,T}$ : A-weighted (equivalent) accumulated energy (dB) for window length  $T$ ,

$p_A(t_i)$ : sound pressure (Pa) samples after an A-weighting filter is applied,

$p_0$ : reference pressure (20  $\mu$ Pa),

$\Delta t$ : sample interval (sec),

$n$ : number of samples,

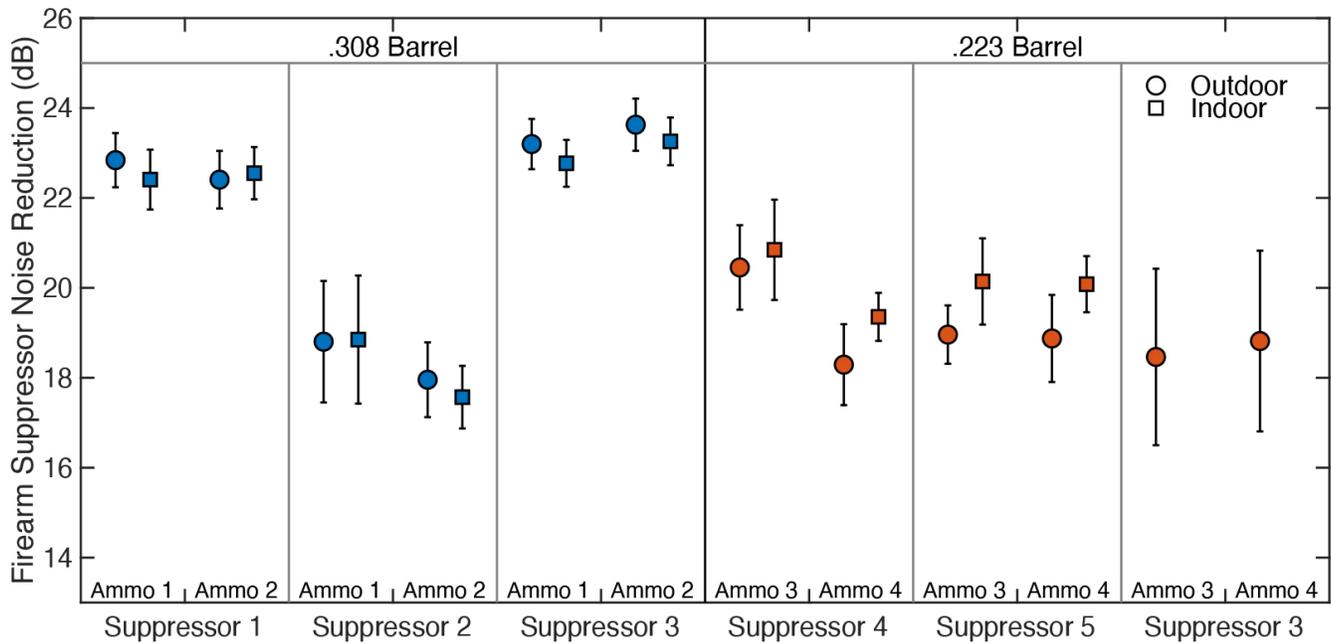
$T$ : window length,  $n\Delta t$  (sec).

The accumulated A-weighted energy metric resulted from firearm suppressor noise research conducted in outdoor and indoor spaces (Murphy et al., 2018b; Tasko et al., 2022; Flamme et al., 2023). The change in the accumulated A-weighted energy is compatible with the A-weighted exposure metric recommended by Brokaw et al. (2023) and with proposed changes to the ANSI/ASA S12.42 standard.

In Figure 2, the sound energy is integrated from the start of the impulse (orange traces) and increases to a maximum within about 10 ms and then begins to slowly subside. Beyond the maximum, the reverber-

ant energy is being dissipated and doesn't add significantly to the accumulated energy. The maximum ( $L_{A,eq,T}=141.9$ ) of the unsuppressed condition occurred at about 2 ms and the maximum ( $L_{A,eq,T}=116.8$ ) of the suppressed condition occurred at about 10 ms. The 25-dB difference between the two maxima could be used to describe the suppressor's performance.

The firearm suppressor noise reductions shown in Figure 3 are from tests conducted at the Oregon Ballistic Laboratories (OBL) with multiple sources, multiple suppressors and in both indoor and outdoor environments. The primary microphone was located at 225° from the line of fire and 2 m from the muzzle of the barrel or the end of the suppressor. Test barrels capable of receiving a suppressor were mounted on a universal receiver. For the .308 caliber barrel, three suppressors were evaluated in both indoor and outdoor conditions. For the .223 caliber barrel, two suppressors were evaluated in both indoor (square symbols) and outdoor conditions (circle symbols) and one of the .308 caliber suppressors was evaluated



**Figure 3.** Noise reductions of several firearm suppressors measured indoors (squares) and outdoors (circles). The caliber of the barrels were 0.308 (blue filled symbols) and 0.223 (orange filled symbols). Suppressor 3 was tested with both calibers of ammunition. Ten shots for each condition were measured and the means and standard deviations are shown.

with the .223 caliber test barrel (see Figure 3). The dimensions of the indoor test space must be considered to ensure that the arrival of any reflections from the walls and ceiling are sufficiently delayed relative to the unsuppressed muzzle blast. Good agreement was found within the suppressors measured in the respective environmental conditions. For Suppressor 3, which was measured on both the .308 and .223 caliber barrels, the difference in the noise reduction was about 4 dB. Presumably this difference was due to the larger gap between the bullet and the internal bore of the suppressor. Gases could more easily escape around the bullet as it passed through the suppressor. Noise reductions in this study ranged between 16 and 25 dB.

## Conclusions

Firearm noise assessment is complicated. A universally agreed upon DRC does not exist. The metrics are not necessarily compatible and require further investigation. The environment, the measurement method and the quantity measured can affect the outcome and subsequent estimate of any risk of noise induced hearing loss. This brief article has considered how personal protection equipment (hearing protection) and engineering controls (noise treatments and firearm suppressors) mitigate impulse noise exposure.

HPDs can reduce firearm noise by 30 dB or more under ideal conditions. However, HPD effectiveness depends upon the individual user, how well the hearing protection fits, and whether it is actually worn. Noise treatments can remove reflections of impulse noise, but might not affect sound propagating directly from the gun to the listener. Properly installed firearm suppressors reduce the muzzle blast energy and will reduce the blast energy received by the ear. Suppressors and noise treatments may not eliminate the hazard, so properly fitted and used HPDs with individually-measured attenuation should still be worn by people exposed to firearm noise. Hearing conservation professionals need to be aware of how to assist their clientele to take the bang out of firearm noise.

## Acknowledgements:

The NHCA Recreational Firearm Taskforce has collected data over several years near Rudyard MI. Deanna Meinke, Michael Stewart, James Lankford, Donald Finan, and Kristy Deiters have been invaluable partners and co-investigators in this research. In 2017 and 2019, Knox Williams and Owen Miller of the American Suppressor Association arranged for testing of suppressors. The data in Figure 3 were collected at the Oregon Ballistics Laboratories and was sponsored by the American Suppressor Association.

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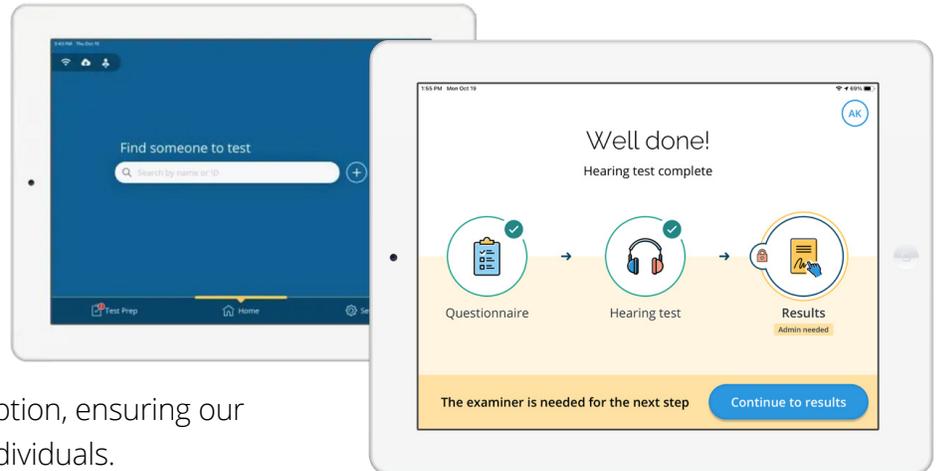
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## Message from the Director of Education

by Andy Merkley  
NHCA Director of Education

NHCA and CAOHC continue to enjoy remarkable success with their regular webinar series. In 2024 we have held three outstanding webinars related to determining work relatedness of hearing injuries, award winning ideas for preventing noise induced hearing loss, and hearing protector fit testing. Attendance at these webinars ranges from 81 to 306. It is exciting to see the energy behind these webinars and the professional diversity of the attendees. We had a fantastic

inaugural NHCA Fall Virtual Educational Summit and will continue with regular [webinars](#). Future topics include noise abatement strategies, monitoring audiometry for worker readiness vs. noise exposure, and basic training of Certified Safety and Health Officials (CSHOs). We look forward to continuing this partnership with CAOHC and providing educational activities that meet the needs of the greater hearing conservation community.



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# NHCA Scholarship Foundation News

by Jennifer Tufts

*Incoming NHCA Scholarship Foundation Chair*

As the incoming chair of the NHCA Scholarship Foundation, I want to acknowledge the service of Dr. Marjorie Grantham, outgoing chair, and Dr. Lynnette Bardolf, who served as chair before Marjorie. While I was chair-elect, Lynnette graciously extended her service for an extra year, and Marjorie graciously succeeded her, at a time when I was unable to assume the duties of chair. I'm grateful to both of these wonderful people for stepping up in service to the Scholarship Foundation during a challenging time for all of us. Lynnette and Marjorie, heartfelt thanks from me and the entire board!

I also want to acknowledge the service of Dr. Kara Cave, who completed her term as secretary of the board in February. As anyone who has worked with Kara knows, she has a wicked good work ethic (and yes, we share a Boston connection). Kara, many thanks from me and the entire board for your service!

We're pleased to announce the availability of the following award for 2025:

## Student Research Award

The Student Research Award (SRA) provides \$1,000 to support graduate-student research in hearing conservation/hearing loss prevention and up to \$1,000 in additional funds for travel and registration expenses to present the funded research at a future annual

NHCA conference. The award is intended to support research studies such as dissertations, theses, or other special projects that are in the planning stages or currently underway. Completed projects are not eligible. For a complete list of requirements and instructions regarding how to apply, [click here](#). Interested students must submit the online application by the deadline, **March 15, 2025**.

## Student Conference Award

The call for applications for the 2025 Student Conference Award (SCA) closed on October 31, 2024. Students interested in applying for the SCA for the 2026 conference will have the opportunity to do so beginning in the late summer/fall of 2025. The SCA includes paid registration to the annual conference, reimbursement of travel expense up to \$1,000, and one year paid student membership of NHCA. This one-time award is available to students who are actively pursuing a graduate degree in a discipline related to hearing conservation and who are enrolled at least half-time in an accredited university program. For a complete list of requirements and instructions regarding how to apply, [click here](#).

**Thank you for your support!**



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# Member Spotlight

## Don Finan

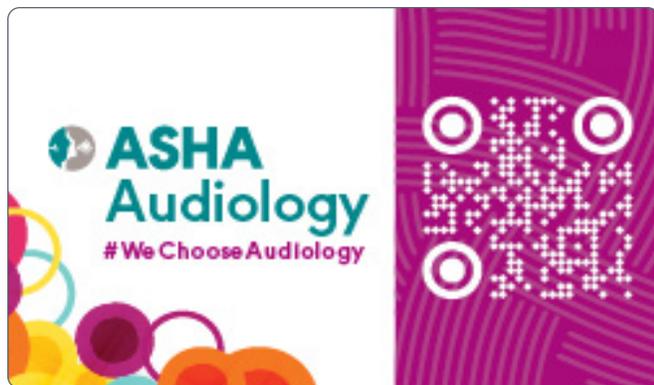
Don Finan has been a regular at the NHCA conference since he first attended in New Orleans in 2012. While he jokes that it was the vibrant atmosphere of the Big Easy during that meeting that keeps bringing him back, the fact that we haven't returned to The Jazz Capital since suggests there are other reasons for his affinity. He recounted that "people were extremely welcoming" when he entered NHCA as a speech scientist, outside the typical domains of audiology, hearing science, or hearing conservation.

Don has held various roles on the Executive Council, from Director of Membership to co-chairing the Website Task Force (for which he and Liz Materson were presented the 2023 Golden Lobe award), and has made significant contributions to the organization. His name is a staple in the conference program, where he consistently delivers some of the most engaging lectures. This is not just an opinion of the author but a fact, supported by his winning the 2020 Outstanding Lecture Award and his presentation of the 2021 Gasaway Lecture. Additionally, Don bears the unofficial role of conference photographer, providing us with many professional photos of the presenters, though fittingly we have only a few candid and shaky photos of Don himself.



Don is the department chair and professor in Communication Sciences & Disorders at the University of Northern Colorado. It was at UNCO that he began working with Deanna Meinke and was invited to join the renowned "Rudyard Gang," which studies firearm noise. He recounted the conversation going something like, "Ok, so we'll go off in the woods, people will be shooting guns and making measurements. That sounds interesting; let's do it." This partnership led to his involvement with the Dangerous Decibels program, including hosting Jolene build workshops across the country.

Outside of his professional work in acoustics, speech science, and hearing, Don has a lifelong passion for



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music. He remembers starting to play guitar simply to hear sounds he liked. Now, he regularly attends blues jams and performs with his band The Rhythm Allstars. His passion for music ties back to NHCA's mission, as he notes, "Talking about guitars is integral to discussing hearing conservation." His love for music and instruments is connected to sound perception, which is crucial for hearing loss prevention and wellness. It all comes full circle.

This member spotlight article was based on an interview which was recorded for the 4th NHCA Spotlight episode of the Talking Ears podcast. To hear more of that conversation, including music from The Rhythm Allstar's excellent 2019 album, click [here](#).



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# Student Spotlight

## Ana Sánchez

by Solenn Olivier  
NHCA Student Member

### ***What brought you into the field of Audiology, and where are you now?***

I am currently a 3rd year audiology doctoral student at the University of Colorado-Boulder. I'm originally, from Oregon and I completed my B.S. at Portland State University. I was a biochemistry major and was taking American Sign Language (ASL) classes as I was always interested in learning the language. In my ASL classes they talked about Speech Language Pathologists (SLP) and AuDs and I became more and more interested in those fields. I ultimately got my B.S. in Speech & Hearing Sciences.

Growing up I have always had hearing and balance concerns with no definitive answer to my issues. I obtained an audiology technician and administrative position at a private practice in New Mexico. Working there solidified that I wanted to be an audiologist! A few months after I started working there, I experienced a sudden hearing loss for several hours. Thankfully, my hearing returned to normal, although the symptoms I had previously became more prominent. I have seen several audiologists and otolaryngologists who could not provide me with definitive answers. This fueled my drive to go back to school to figure out what could be wrong with me and to ultimately help the quality of life of the patients I serve.

I have been a hearing aid user for about 1.5 years now and have found that I am able to build rapport much faster with my patients as I am able to connect with them on a different level. I am interested in working with veterans who may require specialized care. Such as those who have experienced traumatic brain injuries, balance disorders, tinnitus, auditory processing disorders, or hearing loss that may be related to combat exposure. I will be completing my 4th year externship at the Colorado Springs VA next year!

### ***Who was the most influential person(s) in your career?***

As a first-generation college student who will be the first doctor in my immediate and extended family, my parents have always played a part in my education and career choices. From a young age, they encouraged me to pursue my interests and have provided the support I needed to follow my ambitions. They taught me the value of hard work, resilience, and continuous learning – qualities that have been instrumental in my professional journey.



### ***What do you think is the most important challenge facing hearing conservation?***

There are several factors that make hearing conservation a challenging topic to overcome. Ultimately, I believe it comes down to raising awareness about the long-term effects of noise exposure. I think it is inherently known that loud noises are harmful, why else would people cover their ears in the presence of a sudden noise? What isn't well known is about the cumulative damage that these loud sounds could cause to your hearing over time.

### ***What can be done to address this?***

Addressing these challenges requires a combination of public education, stricter enforcement of existing regulations, technological innovation in hearing protection, and more accessible hearing health services.

**How has the COVID-19 pandemic affected you professionally, and how have you handled it?**

The COVID-19 pandemic brought significant changes to my personal life which influenced my professional life. I personally have been through 2 diagnoses of COVID-19 which have exacerbated my postural orthostatic tachycardia syndrome (POTS) and Ehlers-Danlos syndrome (EDS) symptoms. The first was a few months before the initial vaccine came out. I experienced all the symptoms, and I should have been hospitalized. I experienced long-COVID and till this day still have bouts of shortness of breath and cannot exercise like I used to. It affects me professionally as I sometimes have a difficult time counseling patients as I lose my breath. How I have handled it is to take my time. Force myself to take breaks in between sentences and to sit down during counseling if I can.

**Of what accomplishment are you most proud, professionally?**

I am proud to have obtained my 4th year externship placement at the Colorado Springs VA. I did my summer placement there and enjoyed every moment of it. It certainly helps to have fun and passionate preceptors to learn from in such a welcoming environment.

**Of what accomplishment are you most proud, personally?**

I am the Earmold Clinic Coordinator for my Student Academy of Audiology chapter. I helped start a collaboration between Westone Laboratories and the Golden Buffalo Marching Band at my university. We

provide hearing evaluations and ear mold impressions for custom hearing protection at a heavily discounted rate. At earmold fitting appointments we offer Real Ear Instrument Gain (REIG) to confirm their hearing protection is meeting the attenuation requirements needed for the level of attenuation the students selected. I am happy to be a part of a group of people who are passionate about preventing noise-induced hearing loss. All the students we have seen have been happy about their new custom hearing protection and are excited to use them for band performances as well as for personal use.

**When you aren't preventing hearing loss, what do you do for fun?**

I am a homebody, and I simply like to binge watch some TV shows or movies and spend time with my two dogs, Chibi and Navi.

**Lightning round:**

**Best place you have ever traveled:** Mexico

**Place you want to visit the most:** Japan and South Korea!

**Favorite color:** Green

**Favorite animal:** Dogs

**Favorite food:** Jajangmyeon, sushi, and Kimbap

**Favorite book:** Harry Potter and the Goblet of Fire

**Favorite movie:** Spirited Away

**Favorite sound:** Rain

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# Hearing Loss Among Noise-Exposed Utilities Workers

Elizabeth A. Masterson  
National Institute for Occupational Safety and Health

When one thinks about the highest risk industries for hearing loss, the usual suspects come to mind... Mining, Construction, Manufacturing, and Railroads (Themann & Masterson, 2019). One doesn't hear too much about the Utilities sector industries, which "provide electric power, natural gas, steam supply, water supply and sewage removal" (U.S. Census Bureau, 2011). Are noise-exposed Utilities workers being overlooked? Over 550,000 workers are employed in this sector (BLS, 2023), about 43% are exposed to occupational noise (Kerns et al., 2018), and 38% of these exposed workers report not wearing their hearing protection (Green et al., 2021).

A recent [study](#) examined audiograms from 13,595 noise-exposed Utilities workers, and 1.3 million noise-exposed workers in all industries for comparison (Masterson & Themann, 2024). The workers were tested during 2010-2019. Hearing loss was defined as a pure-tone average threshold of 25 dB or more in either ear across frequencies 1, 2, 3 and 4 kHz. Table 1 includes selected results, including the prevalence of hearing loss (percent/proportion with hearing loss) for all industries combined and Utilities sector industries categorized using the North American Industry Classification System (NAICS).

**Table 1. Estimated Prevalence of Hearing Loss by Industry within the Utilities Sector, 2010-2019 (N=13,595)<sup>a</sup>**

Industry (NAICS <sup>b</sup> 2007 Code)	n	Prevalence of Hearing Loss (%)	Prevalence 95% CI <sup>c</sup>
<b>All Industries</b>	1,321,980	19.84	19.77-19.91
<b>Utilities (22 and 221)</b>	13,595	24.86	24.13-25.58
<b>Electric Power Generation, Transmission and Distribution (2211)</b>	9,841	24.28	23.43-25.12
Electric Power Generation (22111)	7,326	24.80	23.81-25.79
Hydroelectric Power Generation (221111)	187	36.90	29.98-43.82
Fossil Fuel Electric Power Generation (221112)	101	ISS <sup>d</sup>	ISS
Nuclear Electric Power Generation (221113)	0	ISS	ISS
Other Electric Power Generation (221119)	7,038	24.44	23.44-25.44
Electric Power Transmission, Control, and Distribution (22112)	2,515	22.74	21.12-24.38
Electric Bulk Power Transmission and Control (221121)	124	ISS	ISS
Electric Power Distribution (221122)	2,391	22.88	21.19-24.56
<b>Natural Gas Distribution (2212 and 22121 and 221210)</b>	1,529	24.13	21.99-26.28
<b>Water, Sewage and Other Systems (2213)</b>	2,159	14.60	13.12-16.08
Water Supply and Irrigation Systems (22131 and 221310)	1,749	13.32	11.73-14.92
Sewage Treatment Facilities (22132 and 221320)	298	15.10	11.04-19.17
Steam and Air-Conditioning Supply (22133 and 221330)	145	28.97	21.58-36.35

<sup>a</sup>Adapted from Table 3 of Masterson & Themann (2024)

<sup>b</sup>NAICS = North American Industry Classification System

<sup>c</sup>CI = 95% confidence interval

<sup>d</sup>ISS = not estimated due to insufficient sample size and cell characteristics (configuration of cases and non-cases)

The hearing loss prevalence for noise-exposed Utilities workers (25%) was higher than for noise-exposed workers in all industries combined (20%). Focusing on industry results at the highest NAICS specificity (six-digit), the Utilities industries with the highest prevalences were: Hydroelectric Power Generation (37%), Steam and Air-Conditioning Supply (29%), Other Electric Power Generation (24%) and Natural Gas Distribution (24%).

The Utilities sector has one of the highest prevalences of hearing loss among noise-exposed workers. Most occupational hearing loss (OHL) is caused by exposures to noise and ototoxic chemicals. OHL is preventable and these exposures can be reduced or eliminated using the hierarchy of controls (Figure 1). More attention and better hearing conservation strategies are needed in this sector.

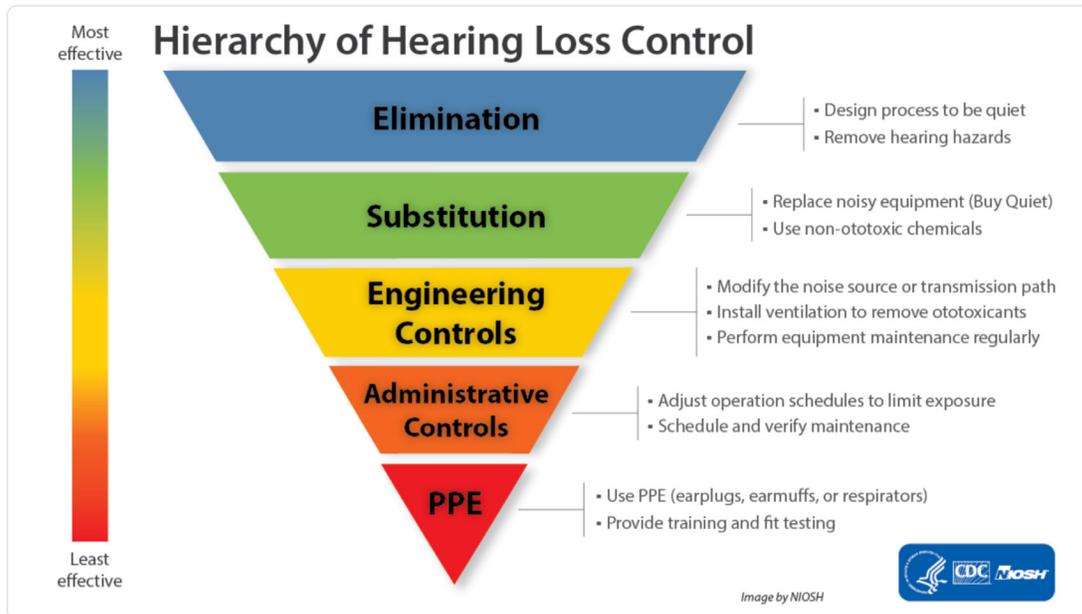


Figure 1: Hierarchy of Controls. From <https://www.cdc.gov/niosh/noise/about/noise.html>

*Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.*

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