

3M Transcript for the following interview: Ep-39 Hearing Protection Device

Ratings Mark Reggers (R) Ted Madison (M)

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Welcome to the 3M Science of Safety podcast presented by 3M Australia and New Zealand Personal Safety Division. This is a podcast that is curious about the signs and systems of all things work, health and safety, that keep workers safe and protect their health. I am Mark Reggers, an occupational hygienist, who likes to ask the questions Why, How, and Please Explain. Whether you are a safety professional, occupational hygienist, or someone with any level of WHS responsibility in the workplace, maybe you are a user of safety products or maybe you are a bit of a safety nerd who finds this stuff really interesting, then this is a podcast for you.

(R) Today we are talking with Ted Madison about hearing protection device ratings.

Welcome Ted.

(M) Hey, thanks for having me.

(R) Not a problem. You're all the way over in Minnesota, so thanks for joining us, another one of our international guests.

(M) Yeah, it's a pleasure.

(R) So, Ted, can you please introduce yourself, where are you from, who are you and what do you do?

(M) Be glad to. I'm an audiologist and I have been working in hearing loss prevention for the last 23 years as a technical service specialist for 3M. My main function in life is to try to prevent noise induced hearing loss. Prior to that I worked as a clinical audiologist helping war veterans who had lost their hearing due to military service and working in noisy occupations. So, I spend most of my time here in the US teaching about hearing loss prevention, helping develop new hearing protectors and trying to motivate workers to value their hearing and to take action to protect it.

(R) That's a key point, keeps coming up in most of our episodes, you can have the best product in the world, but it still relies on that worker to take action to wear it correctly, so it's such an integral part, important part of both our roles that we do at 3M. So, we are talking about hearing protection device ratings, a question I've had many times over the years is you may pick up, or a workplace may pick up or purchase a box of ear plugs or an ear muff from a whole range of different manufacturers but there will be multiple numbers on a box. Why is that the case, because as an example 3M classic ear plug has a number of NRR29 and SNR of 28 and an SLC80 of 23. This is pretty confusing stuff. What's going on?

(M) Well it's just that the test methods used in different regions around the world are slightly different. In the US and in Europe the test methods are designed primarily to measure the capability of the hearing protector. In Australia and New Zealand, the test method also captures the skill of the user, basically how easy the device is to use.

(R) So NRR is noise rating reduction is that correct and that's used in the US?

(M) Right. The NRR is a noise reduction rating and it's based on a test method here in the US, it's used in many countries, the SNR is a single number rating, very similar that's used in Europe and China and a number of other countries. And of course, the SLC80 is unique to your part of the world.

(R) So sound level conversion 80 if I'm correct there?

(M) I believe you're right.

(R) So, I mean if it's the same product and getting three different numbers, I know I probably know the answer to this, but why don't we just have one test rating because it's the same product. Wouldn't that be easier for everyone?

(M) [laughter] It sure would. Getting everybody in the world to agree on anything let alone a test method for hearing protectors is much easier said than done.

(R) I can appreciate that, in Australia we've got some harmonised states as far as the legislation, so taking that to a worldwide scale that can have its challenges and different approaches as all countries and areas do. So, with these different ratings, how broadly, I know they're slightly different as you've said, what is the process to get a number, whatever region, to have a rating on an ear plug, how does that happen?

(M) Well, even though the test methods are slightly different in each region all the different ratings are based on the same type of performance test that's conducted in a laboratory. In a specially designed sound chamber we measure the softest sound that a group of normal hearing people can detect at each frequency. This is known as the hearing threshold.

(R) Do they press a button when they can and can't hear, that sort of like audiology test, audiogram?

(M) Exactly except for using loud speakers in a specially treated room rather than using headphones. So, we repeat the measurement when they're wearing the hearing protection, we compare that to their hearing thresholds when they're not wearing it. So, the reduction in hearing threshold when the hearing protector is worn reflects how much sound the hearing protector is capable of blocking. We call that the attenuation. The test procedure that we are describing is referred to as the real ear attenuation at threshold method. So basically, we take ten to 20 subjects with normal hearing and we test their hearing over a range of frequencies from very low base to very high treble and from that we can calculate the average of the mean and the standard deviation. Not to get too geeky on you but when we calculate the noise reduction rating, or NRR for example, we combine the results across all frequencies and subtract two standard deviations from the mean. Statistically then we can say that 98% of the people we tested in the laboratory obtained a noise reduction rating indicated on the package, or more.

(R) So that group is a representative of all workers everywhere who's ever going to put that ear plug in to what most people should be able to get?

(M) Well I wouldn't go that far. I think it's representative of what a group of very well-trained workers can obtain.

(R) Fair point, fair point.

(M) So, the difference between the test method in the US for example and that that is used in Australia and New Zealand, it has to do with the level of experience of the people who are subject in the test panel and the degree to which the person conducting the tests assists those subjects. Let me give you an example Mark. In

Australia/New Zealand a test is conducted with people who have no experience wearing hearing protection and who are untrained. The person conducting the test gives the hearing protector to each subject and the instructions on proper use. At that point it's up to the test subject to fit the device without any assistance. Using this method captures not only the effectiveness of the device but also the skill of the person at correctly using it. As you might imagine this test method yields somewhat lower attenuation values since the subjects are less experienced.

(R) I guess that's more representative of the real world, so on the workplace there probably isn't someone who is standing behind them showing them, telling them how to fit their ear plug or ear muff correctly each and every time.

(M) I agree, yes. Even though there's more variability when this test method is used the values are closer to the average noise reduction achieved by groups of workers in the real world.

(R) That's what it's all about, I mean there's hearing devices and standards, it's about looking after the worker, so I don't mind that approach from that point of view.

(M) Yeah, it's difficult to arrive at a number though that is consistent and repeatable because of the high variability. So, for example in the US we do somewhat the opposite. We actually used experienced test subjects who have demonstrated very good ability to properly insert and wear hearing protectors. The person conducting the test also coaches and assists subjects to obtain the best possible fit. So, you might not be surprised when this test method yields very high attenuation values. It provides us, the manufacturer, more accurate assessment of the capability of the device with low variability but it doesn't accurately predict how easy the device is to use, or how closely it matches the typical noise reduction levels obtained by workers.

(R) So, with Europe and the SNR rating is that more similar to the Australian/New Zealand test process or the American?

(M) I would say it's more similar to the US test method but it's a blend of the two, the subjects on that test panel are experienced and they do receive some instruction from the person conducting the test but once the test begins the subject cannot be assisted in any way.

(R) I've also seen with the SNR they have a low, medium, high number as well as the single number rating. Can you explain what that's about?

(M) Sure. Yeah so, the single number ratings like the NRR and the SLC80 are designed to give you an estimate of the noise reduction capabilities over a wide range of frequencies, but in Europe they do have a secondary set of values that help to describe the attenuation for different frequencies ranges. So, for noise samples for example that have more high frequency energy the employer can take a look at the label value for the H or high frequency spectrum. Likewise, if there's a lot of low frequency energy in the noise spectrum the employer can use a metric that more accurately reflects the performance for low frequencies.

(R) So that would be very handy for those workplaces that have a bit more handle about the frequencies that their workers are being exposed to, so that would be quite helpful as well.

(M) Sure.

(R) So, with the NRR rating I've heard about De-rating, which kind of makes sense now that you've sort of explained when that test is to get the maximum

performance, so how does D rating work to what a workplace would be working off in the NRR system?

(M) Yeah that's a good question. The research over the years has suggested that most workers or at least many workers will receive less noise reduction than indicated by the single number ratings, in particular the NRR and this is caused by variation in the hearing protector fit, the fitting skill and the motivation of the user. So, the regulatory agencies have adopted an approach of De-rating or reducing the level of the noise reduction rating by certain percentage in order to more closely reflect the protection in the real world. In the US we typically use a 50% De-rating and in different countries in Europe there are different levels of De-rating from a flat 5 dB for example to a certain percentage of the NRR or the SNR value.

(R) Fifty percent, that's a big drop, could be misleading to see a very high number on a box but really, you're working off half of that number.

(M) Well, and that's just a reflection of variability in the way people use devices, right? Yeah, one way to think about it is the noise reduction ratings are a bit like the mileage rating on your car or truck. They're not a prediction of how well you are going to drive, it's simply a description of the efficiency of the vehicle and the same is true with noise reduction ratings or the SLC80, they give you an idea of the effectiveness of the device at blocking sound, it doesn't necessarily reflect how well you might wear it on any particular day or how well it fits your ear in particular.

(R) With these different rating systems have pros and cons, are you more favourable to one over the other and how should workplaces approach these different numbers?

(M) Well I think they each have pros and cons. If you're wanting to understand the true capability of the device I would say the NRR may be the most accurate

representation of that, just looking at the materials and the construction of the device. On the other hand, if what you want is an accurate or more accurate reflection of sort of the typical performance then I would say the SLC80 would be the most useful number to use.

(R) I know we've got some ear plugs in Australia, they are the exact same ear plug but one's corded, one's not corded but they actually have a different SLC80 rating so would that come down to that particular test group and what they achieved as a whole?

(M) Yes, the variability of the test method used in Australia is rather high so for even the same product tested twice you might get very different results and that of course is the difficulty, the accuracy of that number is somewhat questioned when we see that high variability.

(R) So if I'm a workplace and I'm looking in a catalogue or looking online at different brands and I've got an ear plug that's say 23 dB rated, SLC80 and I've got another one that's 24 dB SLC80 rated, how do you approach that situation because it's going to come down to that variability of the test group but we're all humans, we see a high number we think that must be better.

(M) Sure. Yeah, it's safe to say that the differences of 2 or 3 dB between one hearing protector and another are not significant from a statistical point of view, so I wouldn't make important decisions about one hearing protector over another based on only one or two dB. The difference really isn't there.

(R) So that's where the class system comes into Australia where they group hearing protection devices of a certain range into Class 1, 2, 3, 4 and 5 and workplaces in Australia/New Zealand under our system should be basing their decisions on the

classes because of that small variability as you just said there, doesn't really come into the big picture of things.

(M) So true.

(R) So alright, I have selected an ear plug, hypothetically say it's a Class 3, sound level conversion 80, 21 decibels, what actual level of attenuation is a worker going to achieve if we've got all these real variabilities in the testing process, what number should a workplace be working to as far as attenuation point of view?

(M) Yeah that's the difficulty because some workers will obtain much more than 21 dB, and some will obtain much less, there's really no way to know with confidence how much protection any particular worker's obtaining simply by looking at that SLC80 value. For example, in 2008 we published a study and we found that the attenuation achieved by individual workers who are wearing the EAR Classic ranged from 13 dB to 43 dB at the same company. Without testing each of those workers we may have assumed they were all getting about the same amount of protection.

(R) That's a really big spread of results from 13 to 43, that's huge.

(M) Right and you have to keep in mind that these rating systems were designed to estimate the average noise reduction obtained by a group of workers, but they can't be used to estimate the performance achieved by any individual worker. The only way to do that is to conduct a fit test.

(R) So, this lab results versus real world results, what are some of those factors that are going into such a big variance in results to being way over the rating number to significantly underneath the rating number, what's happening in the real world?

(M) Well all kinds of things Mark. First there is variation in the anatomy of one person's ear to another. The same earplug may block more sound in one ear than another because of the unique size and shape of that ear. You might think of a stopper in a bottle, if it's a fixed shape or size it won't fit every bottle equally tightly and the same is true with a hearing protector of a certain size or shape, each ear will achieve a different level of protection based on the tightness of fit.

(R) So, for a workplace that maybe have one style of ear plug, does that mean statistically you're going to have a percentage of workers that's not going to be an ideal fit for because you're going to have people on the larger end of the ear canal size spectrum and obviously on the smaller size of things. Should you have different size ear plugs in workplaces to cater for that variability?

(M) Absolutely yes, I think that the more diverse the workforce the more diverse the options should be for hearing protection, different sizes and shapes to fit everyone's ears comfortably.

(R) What are some other factors that play into this real-world verse lab results?

(M) Well the workers motivation is very important. We've seen this in numerous studies that workers who are personally motivated to protect their hearing may be more likely to take the time and effort to correctly and consistently wear their hearing protection.

(R) That's like any PPE, if you don't put it on, it's not going to protect you at all, so yeah, if people are motivated to wear the right thing and put it on the correct way each and every time.

(M) Right, and if you don't believe that it's important or you don't think it works your motivation to do it correctly may be somewhat less and that gets also to the

whole issue of training and the skill of the user. It's easier to insert a disposable foam ear plug for example, to insert it deep enough into the ear to obtain good protection when you carefully roll the ear plug to make it smaller and when you pull on the outer ear as instructed. Proper training and practice are necessary to help workers obtain this skill and finally it's all about comfort with any PPE. It's a very subjective thing, perception of comfort is correlated with longer wear time which can boost effective protection.

(R) Comfort in anything is going to be always important, if it's not comfortable whatever it is, whether it's a pair of shoes or a piece of personal protective equipment, it's not going to be worn at all or not for the whole time that its needed.

(M) Yes, for sure.

(R) So with all this variability in actual real world results, how would a workplace go about determining what is their level of attenuation is being achieved because that's such an important number when we start looking at a workplace that's done a noise assessment, we know whether it's a 100 dBA average exposure, we want to bring it underneath the exposure standard of 85 dBA here in Australia. How do you get that number to be confident and sure that workers are being adequately protected with the hearing protection device that they're wearing?

(M) Yes, it's such an important step that employers should take. Individual fit testing using an objective scientifically valid method is the only reliable method to assess how well any given hearing protector fits a worker. Although it's not required by law, it can be tremendously beneficial for the employer to identify those employees who may be at risk of hearing loss due to inadequate attenuation. In a 2014 study 3M researchers found that over 30% of workers at a metal container company were not obtaining adequate levels of protection on a baseline fit test. Using the 3M EARfit system, the employer was able to quickly determine if

those workers simply needed to be retrained on proper use or needed to try a different style or size. Once those issues were addressed the personal attenuation rating or PAR of those workers typically improved from 11 to 15 dB.

(R) That's a huge jump but it goes back to all the points we've been discussing, it is that individual fitting, the individual sizing of the ear canal, not having done quite a bit of EARfit hearing protection testing myself, so you get that worker comes in, they'll fit their ear plug, I don't want to give them any assistance and they may get zero, two, three decibels of attenuation. Two minutes of training, do this, lift your pinna up, roll it down, you get huge jumps and it's quite satisfying to see that worker appreciate that gee, I may not have been protected to the level I thought I was after all these years, however long that may be, so that two minutes of training made the world of difference to get such a bit jump. It's very powerful.

(M) Yes, yes, it is. Individual training of any kind is some of the most effective at changing behaviours and as you've discovered when that worker sees exactly how much or how little protection they're getting, it's much easier to show them how to do it better and to document the results right away.

(R) In summing up what we've been chatting about is there any sort of takeaway points you'd like to leave with our listeners around these hearing protection device ratings, in this individual personal attenuation rating that really is such an important number for workplaces?

(M) Yes, I think the best advice I can give any worker who's wearing hearing protection is to pay attention to your own hearing. Make sure that you're aware, once you've been wearing hearing protection for a period of time, of your hearing status. If you notice that your ears are ringing, a condition we call tinnitus or tinnitis, you hear that ringing or buzzing sound, or if you notice your hearing is dulled or muffled, leave the work area, leave the noisy area right away and check

the fit of your hearing protector to make sure it's fitting properly. Or try a different style or size hearing protector.

(R) Really appreciate your time Ted, I mean we've only just skimmed the surface, it's quite a big area but hopefully what we've covered gives workplaces a bit more information about seeing these numbers and the different approaches on where they're coming from but at the end of the day the important thing is making sure those workers are getting the adequate and desired level of protection for their individual noise exposure. So, for workplaces where can they head if they want to get a bit more information about hearing protection and hearing conservation?

(M) Well certainly take a look at your local regulatory bodies and agencies and their online information, I know Safe Work Australia, WorkSafe New Zealand and other agencies have information on how to do workplace assessments for noise, how to select hearing protectors and guidance on the types of ear protectors that would be required. This is true in individual states and territories as well. ASNZS standards organisation also has good information on how to manage a hearing conservation program. There are a number of international resources through the HSE in the UK and NIOSH in the US and 3M also has a very in-depth resource for you called the 3M Centre for Hearing Conversation that provides details about each step of hearing conservation program that an employer must provide. And of course, I can't stress enough the importance of individual fit testing. 3M strongly recommends fit testing to better estimate the protection achieved by individual workers.

(R) Ted really appreciate your time today to help fill us in about hearing protection device ratings.

(M) It's been my pleasure.

(R) Well thanks for listening everyone. If you have any questions, comments, suggestions for future topics or guests you think would be great to get into the studio, you can shoot us an email to scienceofsafetyanz@mmm.com. You could also contact us by that email if you need any help around hearing protection devices, fit testing, or if you'd like a visit to your workplace, 3M are here to help. You can also visit our website 3M.com.au/sospodcast which has a transcript of the chat that Ted and I have just had as well as resources to some of those things that Ted has mentioned. Be sure to subscribe to the podcast, Apple podcast, Google podcast, Spotify, wherever you get this podcast from so you don't miss any future episodes and if you enjoyed the podcast and found it informative we really would appreciate it if you could take a few moments and leave us a review as it really does help other people to find the podcast. As the Chinese proverb said, "the person who says it cannot be done, should not interrupt the person who is doing it". Thanks for listening and have a safe day.