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Noisy Notes: NRR AND CUSTOM-MADE HEARING PROTECTORS

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*There have been questions regarding the use of the term **NRR**, especially when dealing with custom-made hearing protectors.*

What Does NRR Stand For?

NRR stands for Noise Reduction Rating. Its unit is dB without any suffix such as SPL. It is a measure of the potential of a hearing protection device to decrease the sound level reaching the ear. The higher the NRR number associated with a hearing protector, the greater the potential for noise reduction.

Why Is It So Popular?

The short answer is because all hearing protectors manufactured or used in USA must exhibit their NRR values on their packaging. This is a requirement derived from the USA Environmental Protection Agency's (EPA) Noise Control Act (1972). As a consequence, due to the sheer volume of hearing protectors marketed in the USA, the NRR has become the most popular measure of hearing protectors' noise reduction. Another reason for its popularity is the ease of calculating the noise level of the protected ear (in dBA), by just subtracting the NRR from the ambient sound level (measured in dBC).

So, By Knowing the NRR of a Protector, Do I Know How Much Protection I Am Obtaining?

Definitely NO, you don't!

Are You Telling Me That the NRR Is Not Actually a Measure of the Attenuation of the Protector?

Yes, that is exactly what I am telling you! In a way, the NRR is the highest attenuation that you possible may obtain in a laboratory environment, but this doesn't relate to a real world situation.

So, What's the Use of This NRR?

To answer this question, I will have to go back to how the NRR is obtained and what exactly is its meaning? The story starts with the testing of the attenuation of a number of samples of hearing protectors following the procedures set out in the ANSI Standard S3.19 – 1974. The testing consists of measuring the hearing threshold of least 10 subjects once with the protectors in (occluded threshold) and once with the protectors off (open threshold). The procedure is done at the standard audiometric frequencies between 125 Hz and 8000 Hz. The difference between both thresholds represents the attenuation of the protector for this test and at that frequency. This

procedure is repeated 3 times with each of the 10 subjects. Then, mean values and standard deviation of all subjects are calculated for all frequencies.

So, the NRR is the Average of the Attenuations of All 10 Subjects?

No, we haven't yet finished the story. But we will spare you the calculations. And, don't forget that we have to deal with attenuations at each frequency!

So, there are More Calculations, Right?

Yes, there are, and, in the end, the NRR is obtained! Remember, NRR is the *statistical* result of calculations involving results of at least 10 people's attenuations, repeated 3 times at each of the audiometric frequencies

What is the Significance of this Word "Statistical"?

It means that everyone will have slightly different measured attenuations centred around a mean. There will be subjects that will obtain higher attenuations and other will obtain lower. And those values will not always be the same.

And, mind you, so far we are talking of measurements performed by highly trained individuals in laboratory settings, with all the time on their hands and who are also under supervision. We all know that the situation changes dramatically once we are in the field, where the attention is concentrated on production and not on proper wearing of protectors…

Now, what is the Situation with Custom-Made Devices?

Custom-made protectors are manufactured individually for each wearer from moulds made of their ears. Therefore, in theory no 2 hearing protectors are the same. Even the left protector may be different from the right. That is why custom-made protectors cannot be exchanged! However, the statistics used for the calculation of the NRR can still be applied to the custom-made protectors, even if they are not the same. Consequently, the NRR can and is calculated. That is why they are published in the commercial literature.

But I thought that the EPA Only Specified that the NRR Be Applied to Non-custom Hearing Protection?

In no place does the EPA regulation state any difference between the various types of hearing protectors (custom plugs, non-custom plugs, muffs, etc.).

You Said that the NRR was a Requirement of the American EPA. Does Canada Have Any Regulations?

Canada has no similar regulations. Some provincial regulators require compliance with the CSA Standard Z94.2-14 "Hearing Protection Devices," but there is nothing at the Federal level.

Is the NRR the Only Estimate for the Attenuation of a Hearing Protector Custom Made or Otherwise?

No. There is another way using a device known as FAES: Field Attenuation Estimating System. It measures the attenuation of each ear, of the subject. The entire procedure is fast (less than 10 min.) and does not require sophisticated instrumentation or low-noise level environments. There are presently over 10 manufacturers of FAES that operate using different technologies. The protection measured using a FAES is expressed in terms of PAR (Personal Attenuation Rating) in dB. It is

personal, since it expresses the attenuation of only the person under test, and for that particular test method. The PAR is a NRR-like number, based on the data from one wearer who is the actual user of the device (instead of the group of 10 subjects tested 3 times as required by the Standard).

Can the PAR Be Used for Calculating the Noise Level of the Protected Ear?

Yes, a rough estimate of the noise level of the protected ear in dBA is obtained as the difference between the ambient noise level and the PAR.

Is the FAES Good for Any Other Purpose?

Definitely! Besides testing the actual attenuation obtained by the particular protector, among others, 2 important tasks can be performed:

- Hearing protectors' selection. By testing different protectors, the one that offers the adequate protection is selected.
- Training: after testing, the worker is explained how to better fit his protectors. A second test, repeated right away, shows the improvement obtained.

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