

Defining the minimum attenuations of a personal hearing protector

Gwenolé NEXER

g.nexer@hearingprotech.com

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Today, a personal hearing protector (HPD), whether standard or customized, is sold on the value of attenuation, which is measured at the time of its certification by an approved laboratory. This certification is essential for marketing the product to workers exposed to noise in the European Community.

Until 2010, an HPD was sold and worn without anybody questioning its effectiveness when used in the field.

For years, studies have shown that significant differences could exist between the attenuation values measured in the certifying laboratory and actual values. The Germans were the first to implement measures for the effectiveness of customized hearing protectors; other countries will follow.

The efficiency measuring system for personal hearing protectors, CAPA, developed by HearingProTech, now indicates, along with the user's level of protection, whether the hearing protector meets its specifications. A difference compared to the certified values is of course acceptable, but must be justified, and have proof that the wearer of the hearing protector is sufficiently protected when the hearing protector is within the "acceptable limits".

It seems important today to set the minimum values of attenuation to determine the compliance limit of hearing protection devices.

Protection against noise

E-124.2



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The purpose of this document is to define a minimum level of conformity for the attenuation of personal hearing protectors.

First, we will explain how the attenuation level of the hearing protector provided to the user is determined. We will then see how to determine the minimum compliance for a hearing protector.

1. What is the minimum compliance required by a HPD?

To ensure the hearing safety of an employee, a measurement of the attenuation of the hearing protector he is provided with is performed using a suitable measuring system. This measurement can be made at the time of resetting of new equipment, after two or three years of use, or before deciding to renew the equipment.

A minimum attenuation threshold will be determined for each hearing protector. In case the measured value is below this threshold, the hearing protector will be declared non-compliant.

2. Select the attenuation level adapted at the time of equipping the user

The selection of attenuation at the time of equipping a user is extremely important.

The sound level, communication needs, signal perception, etc. are parameters to be considered while defining the attenuation level required for a user of an HPD. They are described in the EN458 standard [2] and in the SAPAN method [1].

If the choice of the selected hearing protector is done correctly beforehand, then it is sufficient to verify it as "compliant" to ensure that its user is properly protected.

3. How to determine the minimum attenuation of a personal hearing protector

A minimum attenuation must guarantee the user of an HPD that the product he wears protects him effectively on two conditions:

- 1 - The choice of HPD and its attenuation were set correctly, based on the environment and the specificities of its wearer [1].
- 2 - The HPD must be worn throughout the period of exposure to noise.

We will have to set a threshold below which we will no longer have the assurance that the hearing protector being worn has a sufficient attenuation level to protect its user.

We shall describe four variables that we use in our assumptions:

SNR: Certified mean loss displayed by the manufacturer (Single Number Rating)

AVA: Attenuation Value Assumed *in situ*

AVM: Attenuation Value Measured *in situ*

AVR: Attenuation Value Required

Step 1

Many studies [3] and recommendations by referring organizations indicate that the attenuations displayed on HPDs are overestimated; an equivalent reduction with two standard deviations (instead of one) is recommended. This reduction on average amounts to a decrease in the SNR of the HPD by 5 decibels [4]. We integrate this first reduction of 5 dB; it will normally be— which is 5, also taken into account when choosing the HPD [1].

$AVA = SNR - 5dB$ (The SNR of the HPD is reduced by 5dB)

Step 2

We estimate that the monitoring system of the attenuation of the HPD can have an uncertainty of measurement that can be plus or minus 5 dB.

$AVM = AVA \pm 5dB$

In addition to the reduction of five decibels, we also have an uncertainty of measurement that requires a margin of five additional decibels for safety reasons.

We thus obtain a minimum attenuation of **SNR - 10dB**

We consider that an HPD having a difference higher than 10 dB between the SNR value and AVM value may be considered non-compliant.

If $SNR - AVM > 10 dB$, then the HPD is non-compliant.

Take a look at the concrete case illustrated in Figure 1.

- A person is exposed to a noise level $Lex_{8h} = 97 dB (A)$
- In the event that the ideal actual level at the ear for this person when he is equipped with personal hearing protectors is $77 dB (A)$.
- To enable us to achieve this, the AVR should be $97 - 77 = 20 dB$
- The HPD proposed should therefore have an AVA of $20 dB + 5 dB (discounted) = 25 dB$
- The AVM value must not be less than the $SNR - 10$ or $15 dB$. Else, the HPD would be considered non-compliant.

An HPD whose average attenuation displayed is $25 dB$ may be appropriate in this situation. Its AVM value should not be less than $15 dB$. Else, the HPD would be considered non-compliant.

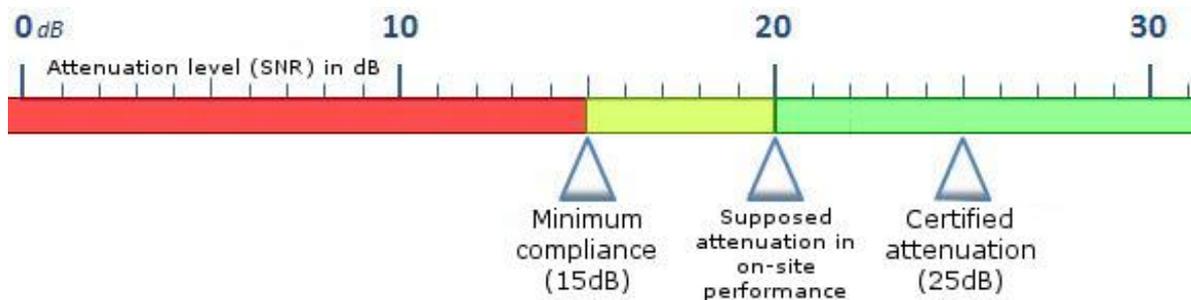


Figure 1: Differences between the displayed attenuation, the assumed attenuation, and the minimum compliance of an HPD whose displayed SNR is 25dB

Figure 1 shows the proportion of HPD that should be compliant if two standard deviations are subtracted 5 with the average of their attenuations. A 10 standard deviation representing approximately [4], two standard deviations represents the minimum attenuation. We find that we would have 98% of compliant HPDs.

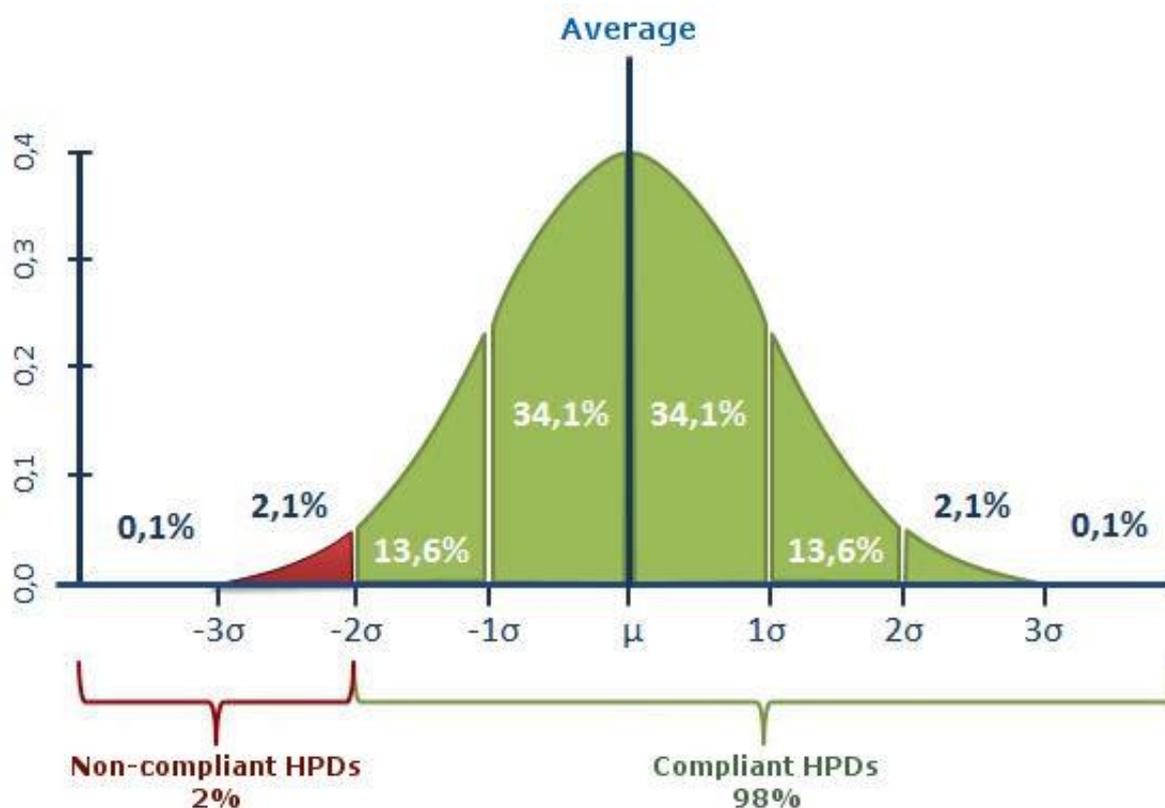


Figure 2: Estimated distribution of compliant and noncompliant HPDs when they are measured

4. What should be done in case of a non-compliant hearing protector?

In the event that the control measure indicates an attenuation value less than the minimum set for the controlled hearing protector, measures must be implemented to overcome this failure of the HPD.

The steps to be taken are as follows:

- 1 - Check that the hearing protector is adapted to the wearer
- 2 - Check proper implementation of the hearing protector in the ear
- 3 - Carry out a new measurement
- 4 - If this new measurement confirms the non-compliance of the hearing protector, replace the defective or unsuitable hearing protector

5. Bibliography

- [1] G. Nexer, *SAPAN - Select the Appropriate Protection Against Noise - Methodology*, HearingProTech, 2012.
- [2] *EN 458 - Personal Hearing Protection - Recommendations for selection, use, care and maintenance*, 2005.
- [3] A. Kusy, *In situ sound attenuation of personal hearing protectors*, INRS, 2008.
- [4] G. Nexer, *Radiography of HPD*, HearingProTech, 2013.