

What is the difference between CAPA and audiometry tests?

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Based on a close measurement method, the objectives of the two systems are different.

The audiometer will produce a graph called an audiogram, representing the hearing ability of a subject.

CAPA measures the attenuation of a personal hearing protector. It does not measure or even estimate the hearing level of a subject.

The audiometer diagnoses hearing loss; CAPA diagnoses loss of attenuation.

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1 Operation of the two systems

Both systems perform a pure tonal measurement of hearing thresholds in air conduction. The method is subjective. The subject is asked to respond as soon as he perceives a sound, even if it is very weak, that is continuous or pulsed at certain fixed frequencies, with the aim to locate the hearing thresholds for each tested frequency.

The tested frequencies can be set in the audiometer. They are defined and not modifiable in the CAPA system. Generally, the hearing threshold is determined for the frequencies 125, 250, 500, 1000, 2000, 4000 and 8000 Hz.

The audiogram will use a method called "increasing" and "decreasing" to precisely determine the hearing threshold of the subject. CAPA only uses the increasing method. It helps to precisely identify the hearing threshold of the subject, but not his hearing level. CAPA is not used to determine the hearing of a subject; the hearing threshold is sufficient. Two simultaneous measurements are made by CAPA: with a hearing protector and without a hearing protector. The difference between the two measurements will provide an attenuation value by frequency. It will then be averaged using the following formula:

$$\text{PSNA} = 100 \text{ dB} - 10 \log \left(10^{(0.1 \times \text{Aff } 125\text{Hz})} + 10^{(0.1 \times \text{Aff } 250 \text{ Hz})} + 10^{(0.1 \times \text{Aff } 1\text{k Hz})} + 10^{(0.1 \times \text{Aff } 2\text{kHz})} + 10^{(0.1 \times \text{Aff } 125\text{kHz})} + 10^{(0.1 \times \text{Aff } 125\text{kHz})} \right)$$

The PSNA (Personal Single Number Attenuation) is the weighted average attenuation of 7 frequencies measured from 125 Hz to 8 KHz for a hearing protector.

Thanks to an algorithm developed after years of research and recording only an increasing measurement, the CAPA system provides excellent accuracy in decibels in a minimum duration of time; a "classic" test, the longest and most complete, is carried out in 7 minutes, with and without a hearing protector. The results and calculations are immediately available and organized.

The average duration of audiometric testing is ten minutes for both ears with an increment of 5 dB; with an accuracy of 1 dB, the duration becomes twenty minutes.

2 Can we use the CAPA system to measure the hearing of a subject?

Clearly not. As explained above, the CAPA system is not designed to measure the hearing level, but the hearing threshold with and without hearing protection. The comparison between the two will indicate the attenuation level of the hearing protector measured. In addition, for reasons of confidentiality, the CAPA system, since version 3, no longer provides access to the hearing thresholds.

In addition, the CAPA system does not require to be calibrated, since only the difference between the two thresholds (with and without a hearing protector) is taken into account. Sound could, for example, be transmitted at 45dB (A) when it actually is at 47dB (A). The gap will exist in the same way with and without a hearing protector, but the gap between the two measurements will remain the same. Since it is not calibrated, it is not suitable for measuring hearing.

3 Can we use an audiometer to measure the attenuation of a personal hearing protector?

Technically, yes, it would be sufficient to perform an audiogram with and without a hearing protector. In fact, this solution is relatively cumbersome and long. For proper accuracy, we need to reset the audiometer to increase the accuracy of measurement, which will have the effect of increasing the duration, as we have seen. Nearly forty minutes will then be necessary to perform the two measurements, with and without a hearing protector.

3.1 Calculate the attenuation level with an audiometer

Once the two measurements have been recorded, enter the results in Excel to calculate the PSNA with the formula described in the first chapter.

We then obtain the average attenuation of the hearing protector. Refer to the CAPA technical documentation to understand how to handle situations where a subject with hearing loss at one or more frequencies makes it impossible to measure, and how to 'weight' the PSNA.

3.2 Determine the compliance of a hearing protector

CAPA, once the measurement is taken, can determine if the hearing protector is compliant or not, with the option to return it to the manufacturer if it is not compliant. To do this, read the publication by HearingProTech entitled "Definition of minimum attenuation of a personal hearing protector" and apply the calculation formulas by comparing the attenuation values obtained by the hearing protector tested, and those issued by the manufacturer.

3.3 Protection level

The third step is to verify that the attenuation of the hearing protector is adapted to the noise exposure levels of the wearer. We saw that in the CAPA system, we just need to fill in the noise area for one or more users to find out if the hearing protectors are suited to them. In the case of measurement performed with an audiogram, it is sufficient to comply with four methods of calculation described in the EN458 European standard.

3.4 Conclusion

The measurement of attenuation of a personal hearing protector with an audiometer is quite possible but extremely time consuming (about one hour per subject) and complex in terms of calculation. This solution should be reserved for isolated cases. CAPA performs this measurement and calculations in 7 minutes.

It is important to reiterate that the CAPA system does not perform an audiometry.