Acoustics – Advanced

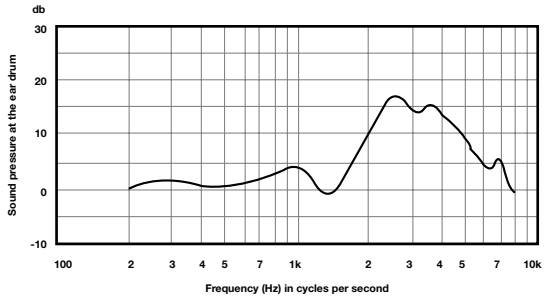
With an understanding of the nature of sound and the concept of a travelling wave, we can apply these principles to the resonance characteristics of the human ear. This is relevant for hearing instrument fittings as it helps to explain real ear measurements and special considerations for pediatric fittings.

The human ear

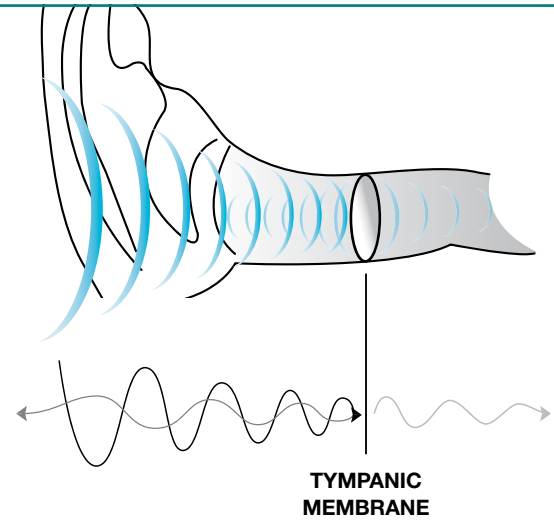
The human ear is essentially a tube that is closed at one end. It is approximately 25mm long and 8mm in diameter. However part of the ear canal is bony, part is cartilaginous and it is s-shaped, not straight. These factors affect the way that sound bounces around in the ear canal. This is what is meant by resonance characteristics.

Other factors that must be considered are the ear canal being closed at one end by the eardrum which transmits and reflects energy. Sound also travels around the head to reach each ear depending on the sound source. This is known as the 'head shadow effect'. The combined effect of transmitted, reflected and travelling sound results in a range of frequencies being widely communicated.

Whilst there are variations in frequency due to the size and shape of the ear canal, there are also variations in intensity. The exact same tone will produce a higher sound pressure level (SPL) in a smaller ear canal (such as an infant ear) than in a larger ear canal (such as an adult ear canal).



The combined resonance effects of sound being both transmitted and reflected by the eardrum and an S-shaped ear canal where part is both and part is cartilaginous.



Energy becomes transmitted by the ear drum while other energy bounces off the ear drum and reflects down the ear canal.

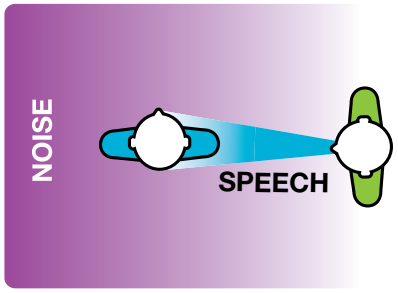
Jargon Buster

Real ear measurements are used to verify that the amount of amplification we think is going in the patient's ear (based on the manufacturer's fitting software) matches what the patient is receiving.

Related information

Also refer to the section in this manual on **Hearing instrument fittings (real ear measures)** and **Pediatric ear canal acoustics**.

Head shadow effect



The right ear is in an optimal position to hear speech coming from the right as the right ear is in the head's "shadow" and thereby protected by noise coming from the left, which must travel around the head in order to reach the right ear.