

# AUDIOLOGICAL ARTICLE

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## THE SPEECH ENHANCER IN MIND440 – IMPROVED SPEECH UNDERSTANDING

**Because communicating in noisy environments is one of the most difficult situations for hearing aid users, Widex has included a noise reduction feature in the mind™440 hearing aid that can increase speech intelligibility in noise.**

### LISTENING IN NOISY ENVIRONMENTS – THE PROBLEM

For many people with hearing loss, listening in noise is one of the most difficult listening situations. The inability to communicate in noise is one of the main reasons why hearing aid users may be dissatisfied with their hearing aids. Therefore, noise reduction is one of the features that receives top priority from Widex.

Other existing noise reduction systems aim to make listening in noisy situations more comfortable by removing the noise from the signal. The risk involved in doing this is that speech cues can also be dampened along with the background noise. The Speech Enhancer in mind440 instead focuses on making the speech signal as prominent as possible. It does this by placing speech above the hearing threshold, while noise is dampened so that it is inaudible to the client. This revolutionary approach gives clients a better chance of communicating in noisy environments.



### THE SPEECH ENHANCER AND THE SII – A STRONG BACKBONE

In order to optimise speech in difficult listening situations the Speech Enhancer in mind440 uses the standardized measure of the Speech Intelligibility Index (SII)<sup>1</sup>. The SII accurately estimates the intelligibility of speech based on how much the assumed speech spectrum is above the hearing threshold of the listener and the noise that is present. This is a strong 'backbone' on which to build a noise reduction system. The Speech Enhancer uses the SII to work out the optimal gain for speech understanding in the current listening environment.

The Speech Enhancer provides clients with the best chance of understanding speech in noisy environments by basing all gain adjustments on the calculated SII. The SII is constantly updated on the basis of information on the current listening situation from the sound analysis functions in mind440. This ensures that gain is always optimised according to the current listening situation.

### NOISE REDUCTION AND HEARING LOSS – ONE SIZE DOESN'T FIT ALL

As well as adapting to new listening environments, the calculation of the SII also takes the hearing loss of the client into consideration. This sets it apart from conventional noise reduction systems that only dampen sound according to the current noise level without any consideration for the hearing loss of the client. Including the hearing loss of the client in a noise reduction algorithm

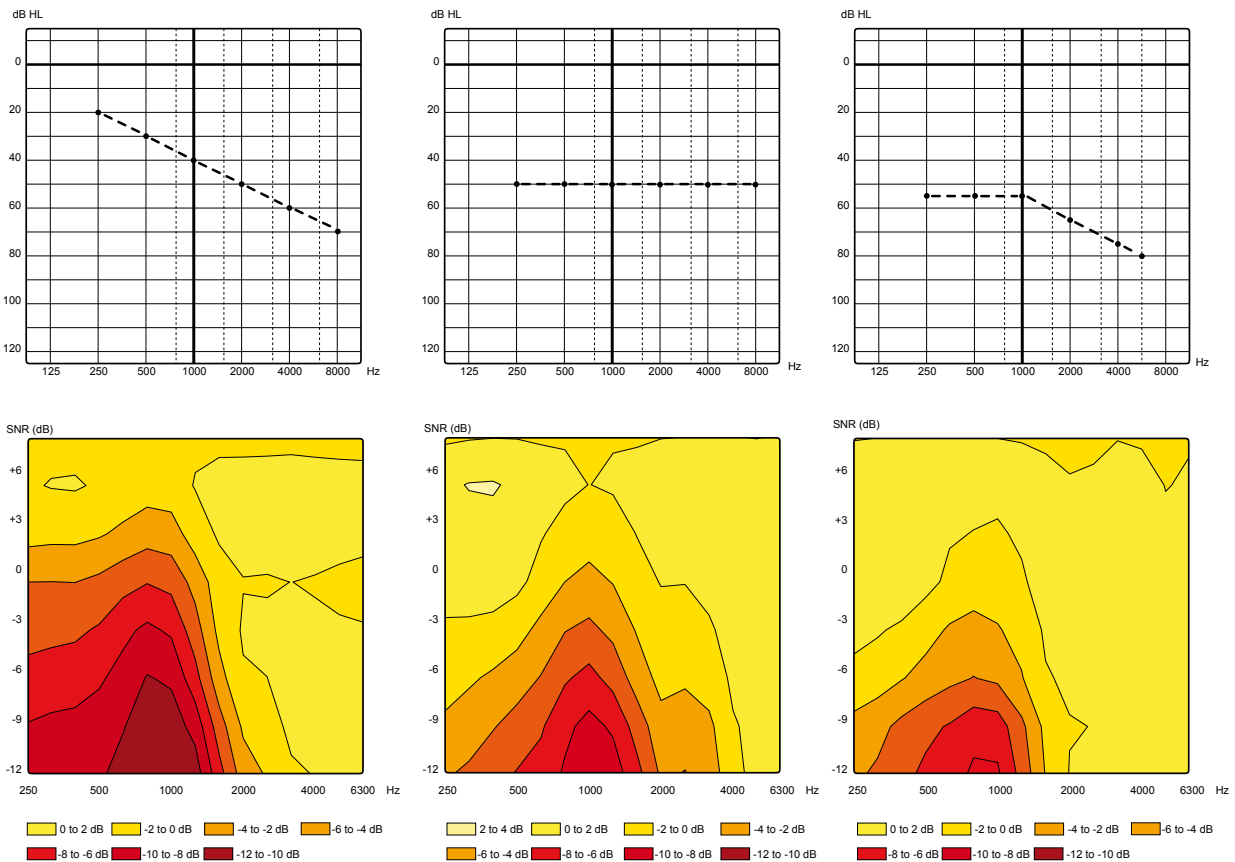


Figure showing the effect of different hearing losses on long-term average measurements of the Speech Enhancer active in different signal-to-noise ratio conditions. Darker colouring indicates greater gain reduction. Measurements were made in a testbox with a speech level of 62 dB SPL (adapted from Smeds et. al., 2009<sup>2</sup>).

has two main benefits: The largest possible amount of speech energy is above the client's hearing threshold and the largest possible amount of competing noise can be placed below the client's hearing threshold.

The figure above shows that the Speech Enhancer reacts differently to different hearing losses (top panels) and signal-to-noise ratio conditions (lower panels). For instance, as the low frequency thresholds become progressively worse, from hearing loss 1 to hearing loss 3, the amount of low frequency damping also decreases as the SNR condition deteriorates (that is, the noise increases). In other words, when there is less hearing ability in the low frequencies, the region which is dampened becomes smaller, as indicated by the size of the dark-coloured regions. Regulating gain differently for different hearing losses is a unique feature of the Speech Enhancer, and sets it apart from other noise reduction systems.

## FOCUSING ON SPEECH

### - EFFICACY OF THE SPEECH ENHANCER

The benefit of the Speech Enhancer has been verified in laboratory experiments. These results suggest that the Speech Enhancer can significantly increase speech intelligibility in noise. In particular, the Speech Enhancer in combination with an omnidirectional microphone gave test participants an average signal-to-noise ratio advantage of 2.5 dB, in a standardised test of their ability to hear in noise<sup>3</sup>.

This is revolutionary as previously only directional microphones have been able to improve speech recognition in noise. The significance of these findings is that they confirm that the Speech Enhancer contributes to speech understanding in noise. The Speech Enhancer in mind440 is therefore the noise reduction strategy of choice for clients who need to communicate in noisy conditions.

## SUMMARY

In the past, noise reduction features in hearing aids have focused on making listening comfortable in noisy environments. This focus does not take into account speech, which can also be present in background noise. The Speech Enhancer, as implemented in mind440, is a noise reduction feature that reduces noise so that it is under the hearing threshold of the listener while boosting regions with speech. The Speech Enhancer is unique as it takes into account the hearing loss of the client. The benefit of this approach is that speech in noise can be better understood, as has been confirmed by clinical studies.

For more information on the Zen program in mind440, please visit [www.widex.pro/mind440](http://www.widex.pro/mind440)

## REFERENCES

- 1 ANSI S3.5. 1997. American National Standard: Methods for the calculation of the Speech Intelligibility Index.
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- 3 Peeters, H., Kuk, F., Lau, C. and Keenan, D. 2009. Subjective and objective evaluation of noise management algorithms. *Journal of the American Academy of Audiology* 20: 89-98.