



Power. Uncompromised.

The goal of any hearing instrument is to provide the best audibility and sound quality possible for the client, whatever the degree of their hearing loss. Fitting people with severe to profound loss presents a unique challenge that requires a fresh approach.

360™ is purpose-built to address the distinct needs of people with severe to profound hearing loss, by delivering all the usable power required to achieve optimal audibility and sound awareness, while ensuring easy adjustment for experienced wearers.





More usable power

360™ fits hearing losses up to 120 dB, offering an impressive peak output of 141 dB SPL and peak gain of 82 dB SPL (2cc), while providing all the power you expect from a hearing instrument in this category. Still, raw power is not enough to overcome the challenges presented by this degree of hearing loss; it needs to be paired with outstanding feedback suppression and advanced features in order to deliver all of the usable power required to achieve optimal audibility.

The feedback problem

People with severe to profound hearing loss know all too well the effects of acoustic feedback. By necessity, they require their hearing instrument to offer the highest gain in order to reach their residual hearing. Unfortunately, this has made them more prone to incidents of acoustic feedback, also referred to as whistling.

360 is purpose-designed to minimize the occurrence of acoustic feedback through the use of a two stage feedback management system and state-of-the-art shell design principles. The result is a super power hearing aid with more than enough gain even for people with severe to profound hearing loss, or a left corner audiogram.

It starts with usable gain

During the fitting process, the 360 feedback optimization test first establishes the maximum allowable gain in each band to deliver uncompromised sound quality before the onset of feedback. 360 then employs a sophisticated phase cancelling system to monitor, detect and adaptively suppress feedback caused by a rapidly changing sound field. Sudden changes to the sound field around the hearing aid could result from jaw movement, a loose earmold, or a hand or telephone near the ear. Using this two step approach, 360 has a feedback management system second to none. Here is the proof:

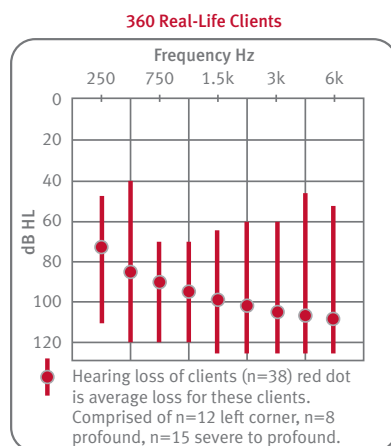


Figure 1.

The sample includes:

- 12 left corner audiograms
- 8 profound hearing losses
- 18 severe to profound rather flat or moderately sloping losses

Unitron Hearing examined fittings from 38 ears collected during the clinical validation for 360. Participants across a wide range and with varying types of severe to profound hearing loss were fitted with 360 instruments following a typical clinical protocol. There are two important items to view in Figure 1, the red bars which cover the range of these clients' audiograms and the red dot which shows the average hearing threshold loss in each band.

To examine the relationship between the measured feedback path and the required gain setting, the feedback optimization data from these subjects was collected and summarized in Figure 2. Special interest was given to the difference between the fitted or preferred gain

setting for the individual and the maximum available gain setting or feedback limit.

In any fitting, it is desirable to have extra room to increase gain above the preferred user setting to:

- Enable users to increase loudness if required
- Allow some reserve gain should hearing further deteriorate
- Adapt to user preference changes

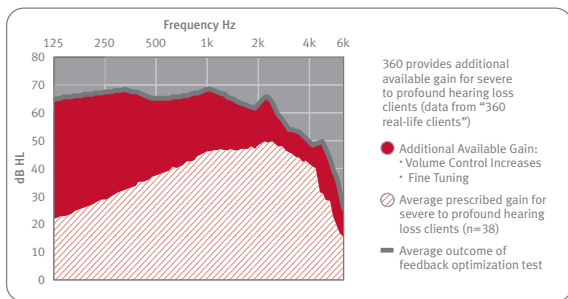


Figure 2. The additional available gain is shown in red. The participant's average prescribed gain or preferred gain is shown by the diagonally striped area. The grey line shows the average outcome of the feedback optimization test.

As shown in the graph, there is a wide margin between the average use gain setting preferred by these participants, and the maximum available gain after feedback optimization. In other words, there is a considerable amount of headroom available to the wearer should they decide to increase their volume control setting. As would be expected, the additional available gain is greatest in the low and mid frequencies, the most important frequency range for people with severe to profound hearing loss. The typical fitting is not influenced by the outcome of the feedback optimization; the maximum usable gain is well above the desired gain for these hearing aid wearers. Consequently, this allows the end user to adjust their volume control to increase the volume without risking uncomfortable whistling from feedback.

Feedback management in detail

360 features a second generation phase cancelling system that builds on the solid processing power and rapid detection systems first introduced in the premium category with the Yuu™ product line.

Designed to maintain maximum power and optimal feedback suppression, 360 deploys a two stage approach when it comes to feedback management. The two components,

feedback optimization and adaptive phase canceller, work in conjunction to provide effective feedback suppression and superior sound quality.

Feedback optimization test

Early in the fitting process, it is important to run a feedback optimization test and verify the likelihood that chronic feedback will occur. This is done by introducing a brief signal into the ear canal and measuring the potential for a feedback loop. It was designed to provide precise results within a few seconds and eliminate ongoing annoying sounds for the wearer.

This In situ test establishes the maximum usable gain level for each fitting and displays the result on screen (See Figure 3). The test result is a direct measurement of the acoustic stability of the entire amplification system. This includes the hearing instrument and the acoustic delivery mechanisms (i.e., earmold, tubing, and venting). A more stable system will provide more headroom and the potential to offer the client a wider range of volume control. If unstable, reduced headroom would be shown on screen as a drop in the maximum available gain, yielding a smaller margin of adjustment between the wearer's preferred gain setting and the maximum available gain.

Thus, the feedback optimization test also provides valuable diagnostic information during the course of the fitting, allowing the opportunity to review such choices as the acoustic seal around the earmold, or the size of the venting provided. Below are a couple of examples of how this works.

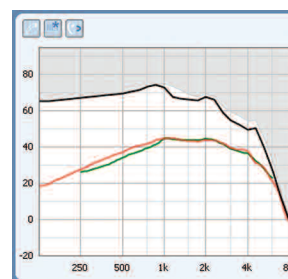


Figure 3.
 Black line: outcome of feedback optimization test
 Red line: prescribed gain
 Green line: NAL-NL1 target

The optimization test typically provides maximum gain levels approximating the maximum gain of the instrument. Figure 3 is a typical example of a feedback optimization test done with a tightly fitted earmold. Although a reasonable fit was provided in Figure 3, the feedback optimization detected a feedback path and as a result, the maximum available gain was slightly limited. There is still considerable headroom available to this the wearer.

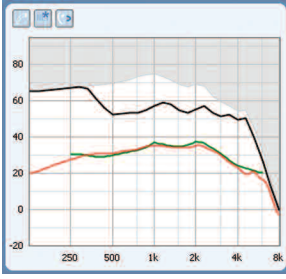


Figure 4.
 Black line: outcome of feedback optimization test
 Red line: prescribed gain
 Green line: NAL-NL1 target

Figure 4 shows the outcome of a feedback optimization test obtained from a subject with a looser fitting earmold and a built in pressure vent. The test showed a higher risk of fit-related feedback and the amount of maximum available gain was reduced. Compared to Figure 3, there is substantially less headroom available to the wearer.

Small differences between the maximum feedback limit, and the preferred gain setting from the instrument, are often the result of acoustic leakage and the presence of feedback paths. To improve the stability of the fitting, and the feedback optimization outcome, you can;

- close the vent
- check the tubing for cracks and acoustic leakage
- re-make the earmold with a tighter fit and better seal

It is always recommended to perform the feedback optimization test to determine the maximum amount of stable gain, so the system can remove the likelihood of fit related feedback. Performing the test, and closely evaluating the results, could prevent embarrassing situations for the wearer, and offer the best possible sound quality.

Adaptive phase canceller

The second component of the feedback management system in 360 is the adaptive phase canceller. The phase canceller is used to monitor, detect, and suppress adaptive feedback caused by a modified feedback pathway.

The detector system is constantly monitoring the processed

sound by comparing the input signal received by the microphone with the output signal at the receiver/speaker. Frequency bands containing highly correlated signals are indicative of acoustic feedback oscillations specific to those frequencies. The adaptive phase canceller is designed to respond to incidental feedback oscillations that typically occur when there are changes to the acoustic feedback path. These changes could be caused by kissing, hugging or the movement of a phone, hand, or hat near the ear. The phase canceller component is designed to rapidly detect and counter these occurrences of feedback to prevent even intermittent whistling. The end result—a feedback free hearing instrument.

Conclusion

Feedback optimization and phase cancelling are two critical components enabling 360 to offer maximum power while suppressing feedback. During external validation testing, special attention was paid to ensure the 360 hearing aids met the goal of providing more usable gain without feedback. Specifically analyzed was the relationship between the desired gain needed to correct a given hearing loss, and maximum available gain after running the feedback optimization test. The data taken from the validation fittings has shown that 360 delivered the desired gain and still allowed the wearer headroom to manually increase volume control when necessary.

With a sophisticated feedback management system, 360 provides more usable gain before the onset of feedback. The result is a powerful hearing instrument that offers pure comfortable listening for people with severe to profound hearing loss.

Author: Frank Jester, Corporate Marketing - Audiology

360 feature articles available:

1. Power. Uncompromised.
2. Delivering Advance Features Tailored for Severe to Profound Hearing Loss
3. Built for Real-life. Built Enviro-Tough™

For more information on 360, visit www.360.unitronhearing.com

