



Technical Information Bulletin

Bulletin No. E-7710

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From: Cardionics Engineering Dept.

Subject: Use of Phonak Savia Hearing Aids with E-Scope Electronic Stethoscope

Discussion: Hearing impaired professionals are in need of a means to detect heart and breath sounds and to measure blood pressure during their routine medical duties. Hearing aids are designed for enhancement of voice sounds that have a frequency range from approximately 500Hz to 4000Hz. Some hearing aids can be programmed for lower frequencies. However, even with this additional low frequency response, hearing aids still are not be able to reproduce the heart and lung sounds adequately for diagnostic purposes. Also, some individuals may have hearing loss in the range for heart and lung sounds that is not compensated by their hearing aid.

Voice sounds range between 500-4000Hz while heart sounds are between 20-650Hz. The first and second heart sounds, which are essential to hear, range between 70-120Hz. The third and fourth heart sounds are in the 40-60Hz range. No hearing aid presently on the market will reproduce a sound low enough to allow hearing the third or fourth heart sound. If a third heart sound (S3) or a fourth heart sound (S4) is suspected, have the patient auscultated by a medical professional with normal hearing. Most murmurs occur between 150Hz and 400Hz.range.

Breath sounds range between 70-4000Hz. However, most breath sounds are under 2000Hz.

Test Protocol:

As a manufacturer of electronic stethoscopes (E-Scope), Cardionics has been concerned that medical professionals may not fully understand the implications of using a stethoscope with a behind-the-ear type hearing aid. In order to validate our concerns and in cooperation the Phonak, we tested the Phonak Savia, model 311 BTE (behind-the-ear) with the E-Scope Electronic Stethoscope, model 718-7710. The *Sounds Output* of the E-Scope was connected to the Phonak Savia using a DAI (direct audio input) cable. A known signal was put into the E-Scope and the output measured at the Phonak Savia hearing aid using a Sound Pressure Meter (SPL).

The Savia, like most hearing aids, uses an adaptive signal algorithm for optimizing hearing for speech and minimizing sound clipping. The algorithm quickly adapts to its environment by suppressing harsh impulses and making fine adjustments to the volume output. The algorithm could not be disabled for this test. However, the speed at which the device reacts was minimized by the manufacturer.

Conclusions and Recommendations:

Our evaluation indicates that sound quality of the Savia hearing aid, when connected to the E-Scope is not suitable for diagnostic purposes. The below frequency response graph shows the limitations of the Savia hearing aid to reproduce sounds adequately in the frequency range for heart sounds when connected to the E-Scope. The below graph has the measured sound output (dBspl) of the E-Scope (blue line) with a constant 85 dB signal input to the chestpiece.

The measured sound output of the Savia hearing aid (red line) with the E-Scope connected is plotted for comparison. For this test, the sounds were applied to the E-Scope/Savia combination in a manner that reduced the effect of the adaptive algorithms in the Savia. Even so, the graph shows that the Savia output is significantly attenuated in the important frequency range below 200Hz. In addition, an informal evaluation was performed in which several test subjects with normal hearing listened to heart sounds with the Savia hearing aid connected to the E-Scope. They found that the heart sounds were faint and distorted.

Cardionics recommends that users of the Phonak and other BTE hearing aids should not directly connect the E-Scope with their BTE hearing aids and attempt to use them for diagnostic auscultation.
