97-03

audioscan®

AppNote

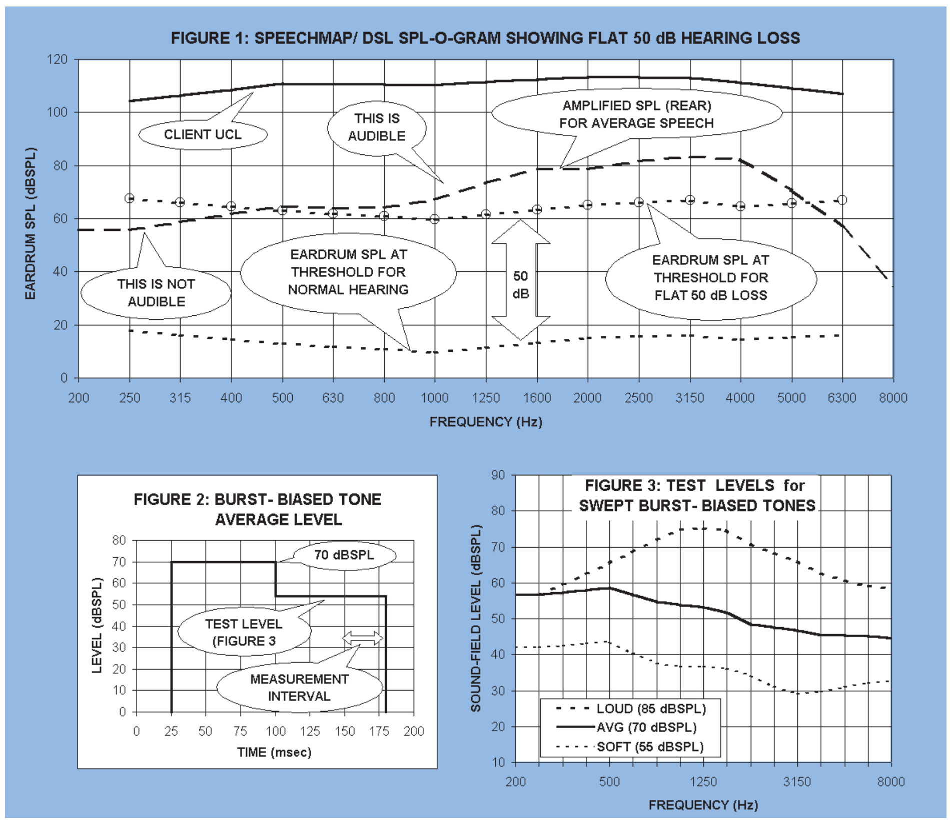
Fitting Compression Hearing Aids using the RM500

with Software version 2.6

Since 1992, Audioscan® has pioneered the use of auditory area mapping and time-varying signals for the fitting of compression hearing aids. In 1994, the developers of the Desired Sensation Level (DSL®) method of hearing aid fitting teamed with Audioscan to produce Speechmap®/DSL, a comprehensive method of fitting all types of hearing aids and FM systems to both children and adults. No other fitting method and no other implementation of the DSL method addresses all the areas necessary for an accurate fitting of compression hearing aids.

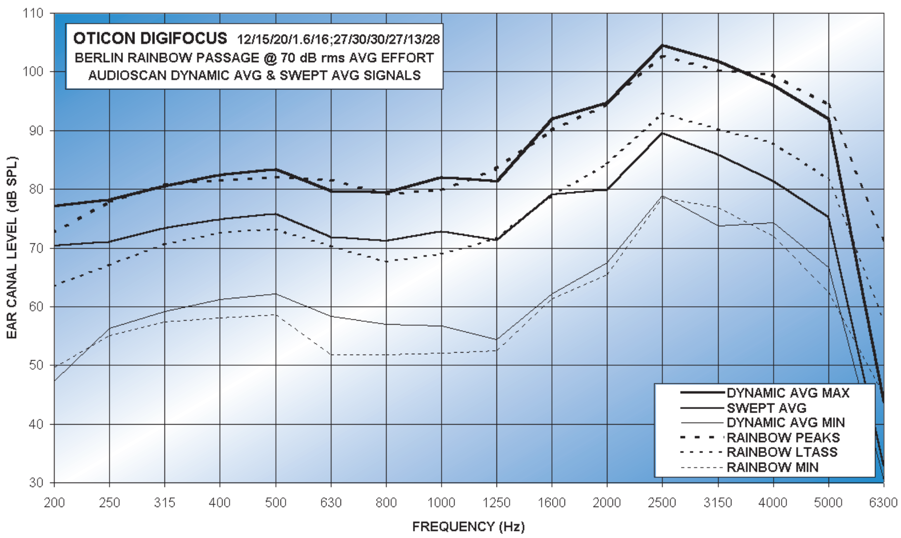
(Continued over)

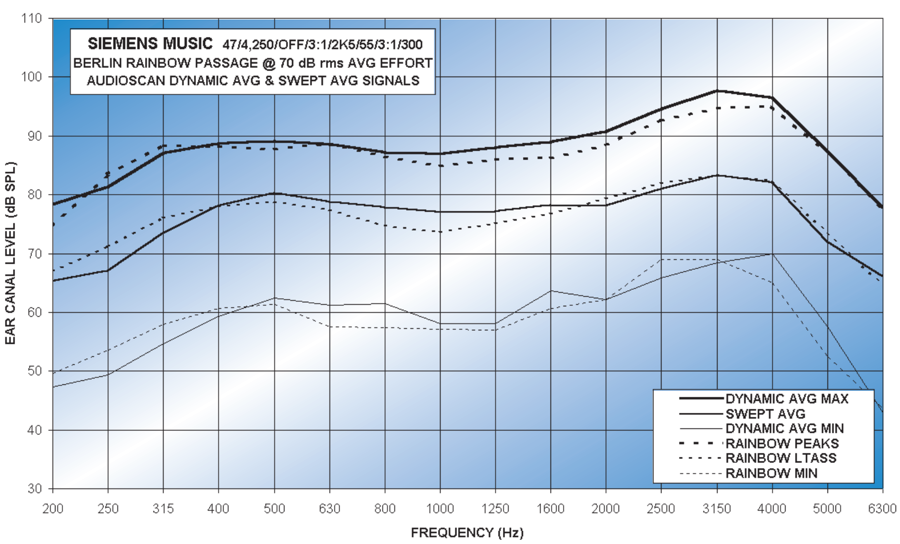
The Speechmap/DSL fitting method plots eardrum SPL at threshold and at Uncomfortable Loudness Level (UCL) on the same chart with measured Real Ear Aided Response (REAR) (Figure 1). SPL levels above the threshold curve are audible and SPL levels below the UCL curve are comfortable. The fitting goal is simply to make soft speech audible without making loud sounds (including loud speech) uncomfortable.

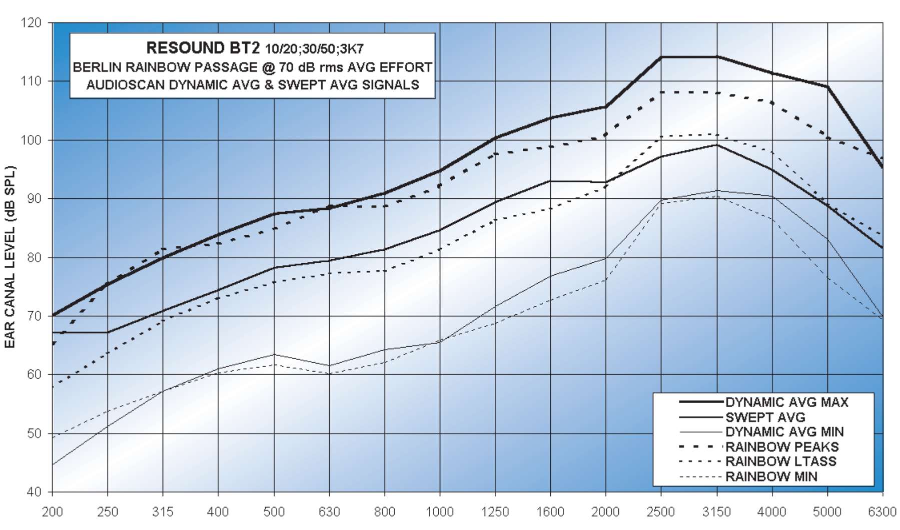


When adjusting hearing aids to make speech audible and comfortable, it is important that the test signals reflect both the temporal and spectral properties of soft, average and loud speech to ensure that they receive the same processing as a speech signal. The Audioscan SWEPT test signal consists of 16 or 64 tones presented in sequence, with each tone constructed as in Figure 2. The 75 ms burst preceding each tone sets the gain of the compression circuit as it would be set by repeated speech peaks while the measurement of hearing aid output occurs during recovery, with the input at the 1/3 octave band level for the speech being simulated. The measurement takes about 30 ms after a delay of approximately (frequency/40) seconds. The frequency weightings used for soft (55 dB) average (70 dB) and loud (85 dB) are shown in Figure 3. The DYNAMIC test signal consists of 64 tones at 1/3 octave frequencies presented at 12 dB above and 18 dB below the long term average band levels of Figure 3. The order of presentation and the duration of each tone are based on the order and duration of significant 1/3 octave band levels in the phrase "Joe took father's shoebench out. She was waiting at my lawn". An additional signal (MPO), consisting of a series of 85 ms tone bursts at 85 or 90 dB, estimates worst case output in response to loud environmental sounds.

Etymonic Design Incorporated
41 Byron Avenue
Dorchester, Ontario
Canada N0L 1G0
1-800-265-2093
Phone (519) 268-3313
Fax (519) 268-3256







Meeting gain targets using steady pure tones or broad-band noise will frequently not result in the 1/3 octave band levels of amplified speech reaching expected levels. Audioscan has dealt with this problem with two unique time-varying signals – a swept burst-biased tone (SWEPT) and a roving bilevel tone (DYNAMIC).

The SWEPT test signal consists of 16 or 64 tones presented in sequence, with each tone constructed as in Figure 2. The DYNAMIC test signal consists of 64 tones at 1/3 octave frequencies presented at 12 dB above and 18 dB below the long term average band levels of Figure 3.

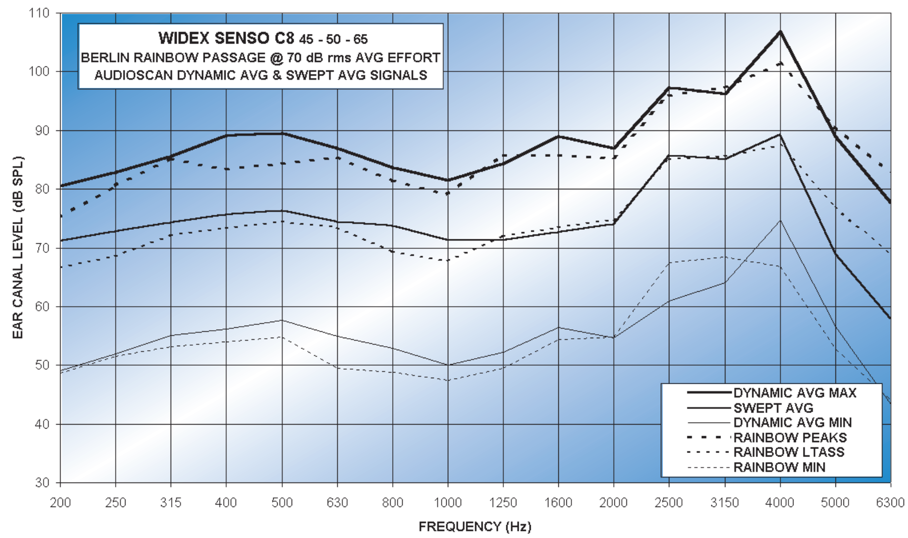
How well these signals estimate performance with real speech is shown for six different compression hearing aids in the figures shown here.

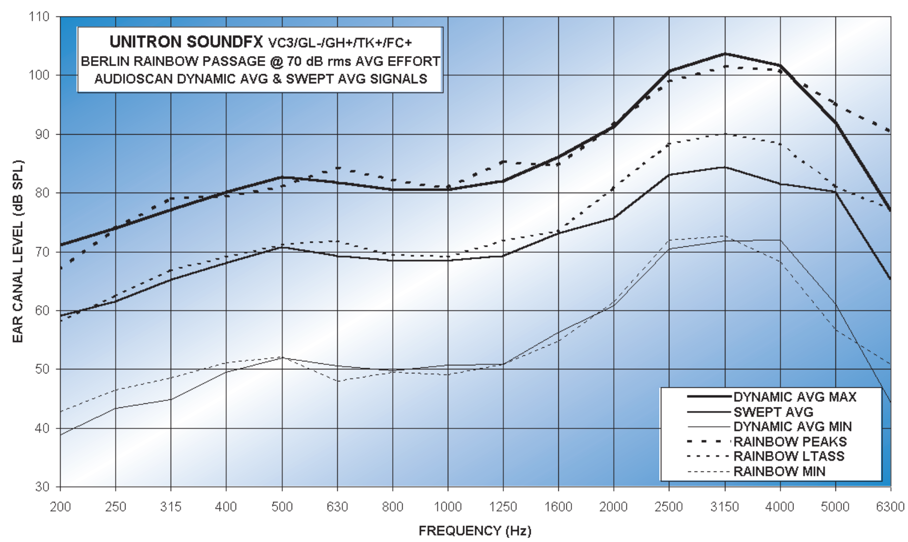
In each case, 2cc coupler measurements of hearing aid output have been converted to real-ear SPL using average adult conversion factors (RECD).

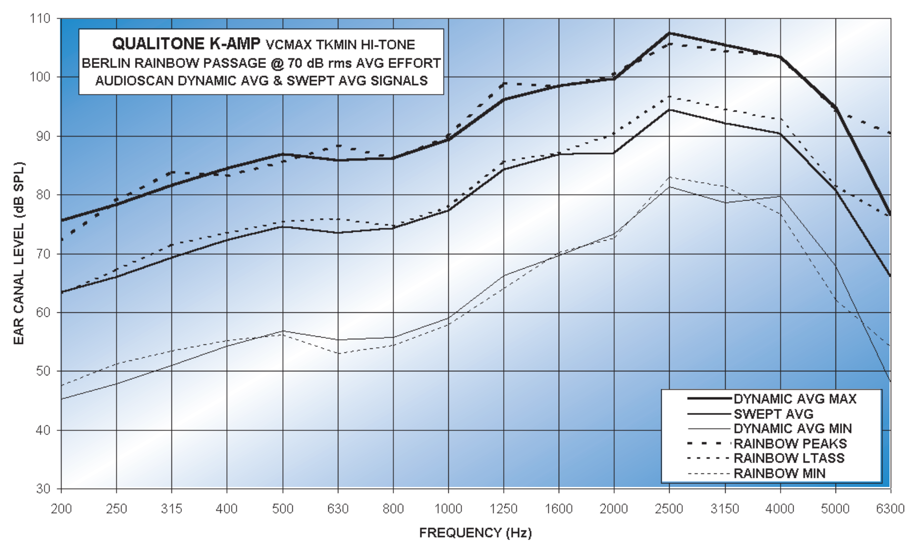
The upper and lower solid curves were measured using the Audioscan DYNAMIC test signal while the center solid curve was measured using the SWEPT test signal.

The dotted curves are 1/3 octave band levels for Charles Berlin reading the "Rainbow Passage". This signal was first equalized to produce the long-term average speech spectrum (LTASS) shown as AVG in Figure 3. The upper dotted curve is the level exceeded 1% of the time, the center curve is the LTASS and the lower curve is the level exceeded 80% of the time (in 1/3 octave bands).

These results clearly show that, for a wide range of compression hearing aids, the unique Audioscan test signals provide excellent estimates of LTASS, peaks and minima for real speech.





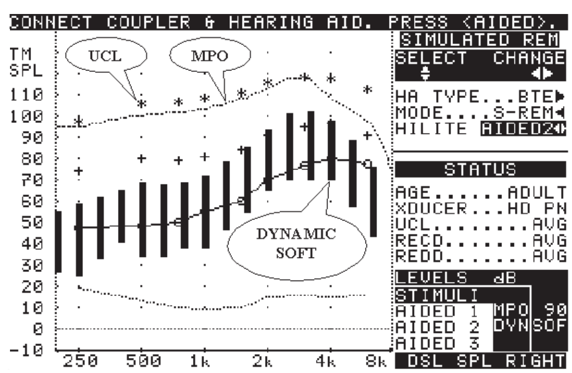


The fitting of compression hearing aids requires the right fitting goals, the right test signals and the right fitting environment With compression thresholds as low as 20 dB SPL and noise-reduction processes appearing in hearing aids, noise in the test area can easily alter the gain of the hearing aid during real-ear measurement. Audioscan's unique solution to this problem is Simulated Real-Ear Measurement (S-REM) which allows you to work in the controlled environment of the test box, yet see your results as if you were working real ear. Age-appropriate average real ear to coupler differences (RECD) and mic. effects for the type of aid being fit are used to estimate SPL at the eardrum as tests are run in the test box. For greater accuracy, a quick (less than a minute) and easy RECD measurement process gives you a more precise conversion from test box to real ear.

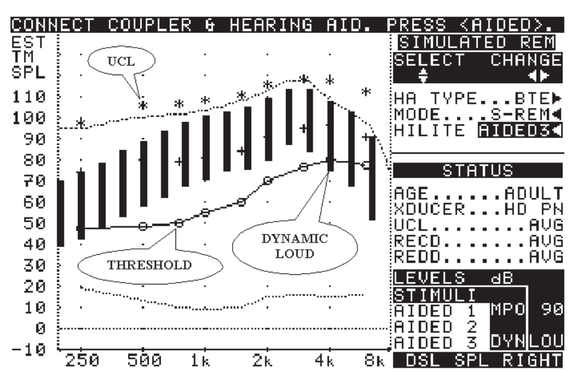
For compression hearing aid fitting, we recommend insert earphones, measurement of UCL and RECD and the use of Simulated Real-Ear Measurements.

The fitting procedure is essentially the same for all types of compression hearing aids. The first decision you must make is whether you want to set the maximum output capabilities of the hearing aid with the volume control at full-on or set to a "use" position. In making this decision, you must consider the needs of your client, the effect of volume control on maximum output and the effect of any maximum output adjustments on gain for soft sounds. If there is no volume control, the decision is easy. If you choose the full-on position, we recommend that you set the maximum output first to avoid having to reset the volume control to the "use" position to verify that the adjustment of output capabilities has not changed gain settings. The following procedure has been written assuming the full-on volume control position has been chosen and that you have entered threshold and UCL data and will be using Speechmap/DSL in S-REM mode. It may also be used for linear hearing aids.

1. Set the hearing aid so that it will produce its highest output. VC full-on.
2. Using the MPO test signal, set output limiting controls (PC, TK, Comp Ratio, VC) so that the output is below UCL at all frequencies.
3. Set the volume control to a "use" setting.
4. Using the DYNAMIC SOFT test signal, adjust the low-level gain (gain, TK, VC) so that the SOFT Quikscan® curve is just above threshold across the widest possible frequency range. Run the complete DYNAMIC SOFT test. 50%–75% of the length of the dynamic range bars should be above the threshold curve between 500 and 4000 Hz Because of the long adaptation time of the WIDEX SENSO®, you will need to wait until the Quikscan® curve stabilizes before running the complete DYNAMIC test.
5. Run the DYNAMIC LOUD test to ensure that the peaks fall below the UCL curve.
6. Set the volume control back to full-on and repeat step 2 to verify that it has not changed significantly. If it has, you will need to readjust and repeat steps 3 – 6.



Audioscan screen for steps 2 - 4



Audioscan screen for step 5

Etymonic Design Incorporated
41 Byron Avenue
Dorchester, Ontario
Canada N0L 1G0
1-800-265-2093
Phone (519) 268-3313
Fax (519) 268-3256