



Software Training Manual

© Copyright June 2004

INTRODUCTION

Congratulations!

Your decision to incorporate the MedRx Avant™ into your daily practice will greatly assist you in delivering quality professional hearing health care services. The MedRx Avant™ is designed for easy use and equips you with excellent counseling tools to interact with the patient and family.

Setup and Install the MedRx Avant™ by following the installation documentation provided with your system.

How to use the Training Manual

To become proficient at using the MedRx Avant™, you need to invest some time in learning the software. This Training Manual provides training lessons to step you through the main functions of the software. It is highly recommended you complete these lessons before using the system with a patient. Repeat a lesson to refresh your performance as needed.

The first lesson "Getting Started" provides basic operation guidelines and an introduction to the software. The subsequent lessons are presented in corresponding order with the main menu. Return to a specific lesson if you need more practice with a specific task. For quick reference to a specific task, use the contents index at the front of this manual. Remember to use the Help provided in the MedRx Avant™ software for further details when they are required.

YOU ARE COMMENDED FOR YOUR EFFORTS TO DELIVER SUPERIOR HEARING HEALTH CARE.

Special Note: At present , the 3 Dimensional Live Speech Mapping menu is being used for research to develop clinical applications for your use. It is offered in the software for you to experiment with at you convenience.

TABLE OF CONTENTS

LESSON ONE	5
GETTING STARTED	5
LESSON TWO	10
OPERATING THE AVANT™ FROM WITHIN NOAH	10
LESSON THREE	16
AUDIOMETRY.....	16
<i>Exercise One: Setting up the Audiometer software</i>	16
<i>Exercise Two: How to perform Audiometry</i>	19
<i>Exercise Three: Obtaining discrete frequency UCLs</i>	21
<i>Exercise Four: Removing unwanted data from the Audiogram</i>	21
<i>Exercise Five: Customizing Audiometry</i>	22
LESSON FOUR	24
SPEECH TESTING	24
<i>Exercise One: How to find Speech Reception Threshold Using the dynamic Wordlist feature</i>	24
<i>Exercise Two: Use the cd player for speech testing</i>	28
<i>Exercise Three: Find MCL for speech</i>	32
<i>Exercise Four: Obtain a Discrimination Score at MCL</i>	33
<i>Exercise Five: Find UCL for speech</i>	38
LESSON FIVE	40
LIVE SPEECH MAPPING	40
<i>Exercise One: Demonstrate the hearing loss to the patient and third party using Live Speech Mapping</i>	43
<i>To Discard unwanted stored curves</i>	46
<i>unaided live speech mapping in DBSPL</i>	47
<i>Exercise two: Verify hearing instrument fittings using Live Speech Mapping</i>	49
<i>exercise three: feedback using lsm</i>	52
<i>Feedback</i>	52
LESSON SIX	54
OCCLUSION EFFECT.....	54
<i>Exercise One: Occlusion Effect demonstration</i>	54
<i>Exercise Two: Measuring the Occlusion Effect</i>	55
LESSON SEVEN	60
REAL EAR MEASUREMENTS (REM).....	60
<i>Exercise One: Using ICRA-Noise to verify non-linear hearing instrument fittings</i>	61
LESSON EIGHT	63
TYMPANOMETRY AND REFLEXES.....	63
TYMPANOMETRY	63
GETTING STARTED	63
REFLEXES	67

LESSON NINE	69
HEARING LOSS SIMULATOR(HLS) AND MASTER HEARING AID(MHA)	
.....	69
<i>Exercise Two: Simulate the potential improvement in the patient's hearing performance when hearing instruments are worn</i>	72
<i>Exercise Three: Use the Hearing Loss Simulator to simulate the natural deterioration in thresholds over time</i>	73
LESSON TEN	78
HEARING INSTRUMENT TEST (HIT).....	78
<i>Exercise One: Hardware setup for Test box measurements</i>	78
<i>Exercise Two: Software setup for Autotest</i>	80
<i>Exercise Three: Software setup for manual testing for specific characteristics of the hearing instrument</i>	82

LESSON ONE

Getting Started

The MedRx Avant™ software runs in a Windows 98 (second edition) or higher operating system. It is assumed you are familiar with operating a mouse and keyboard in Windows. Unless otherwise stated, always use a single left mouse click to select an icon in the Avant™ software.

You will find extensive help for all software functions in the Help files. To access Help, click the question mark *Help* icon on the screen or click Help on the toolbar or press F1 on the keyboard.

It is assumed you have a working knowledge of hearing health care and hearing aid dispensing. You must have a basic understanding of hearing instrument fitting supported by real ear measurements.

ABOUT THE SOFTWARE

THE MAIN MENU SCREEN



Software Version number

Read the version number on the **Help | About MedRx Avant™** window.



AVANT™ SOFTWARE MENU

The main menu screen gives you access to the following functions:

 Audio	AUDIO	Audiogram
 LSM	LSM	Live Speech Mapping
 REM	REM	Real Ear Measurements
 Tymp	TYMP	Tympanometry and Reflexes
 MHA/ HLS	MHA/ HLS	Master Hearing Aid and Hearing Loss Simulator
 3D	3D	3 Dimensional Live Speech Mapping
 H.I. Test	HIT	Hearing Instrument Test box
 Exit	EXIT	Closing the Avant™ program

An additional icon for Video Otoscopy appears on the main menu screen when you select this option to be installed on the Avant™.



BASIC SCREEN DESCRIPTION

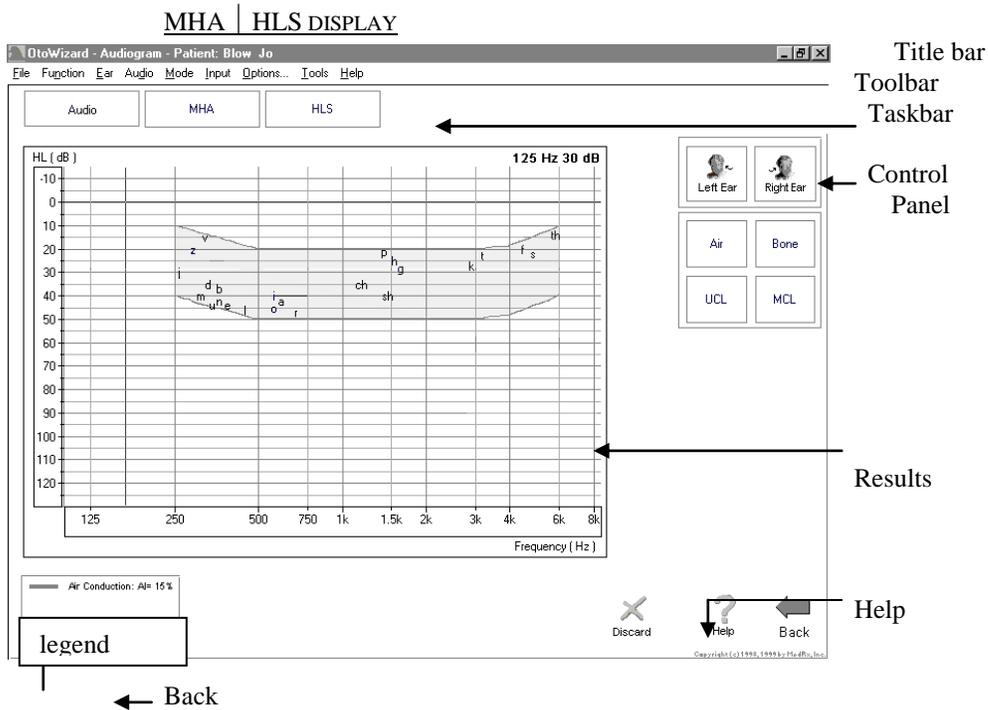
The layout of every screen is consistent throughout the program. The following diagram and text describes this common format. Please read the following paragraph. Do not click on any icons until indicated with *italics*. Try to locate features as they are described.

The title bar at the top of the screen states the function you are performing. If you have a patient folder open, the patient's name will also be on the title bar. For all measurement functions, the results are displayed on a large central grid. The control panel for selecting the test ear, signal inputs and transducers is always located on the right side of the display. A Legend is positioned in the lower left corner of the display and provides a color-coded key to interpret the results on the display. Access Help from the *Help* icon in the lower right corner. To return to the previous screen, use the Back icon in the lower right corner.

(Now is the time for you to click your mouse!)

Click *MHA / HLS* on the main menu.

Identify each basic feature of the display format as outlined above. You should see the following diagram on your screen.



SAVING DATA

Results are automatically stored to the NOAH database when you close a client's folder in NOAH. Lesson Two describes how to operate the Avant™ in NOAH.

EXITING THE AVANT™

ALWAYS use the *Exit* icon on the main menu screen to close the Avant™ program. It is recommended you backup the NOAH database frequently to avoid losing data in case of system failure.

CALIBRATION

The microphones are calibrated annually. Guidelines for microphone calibration are provided by your supporting technician for the Avant™.

Probe Tube Calibration:

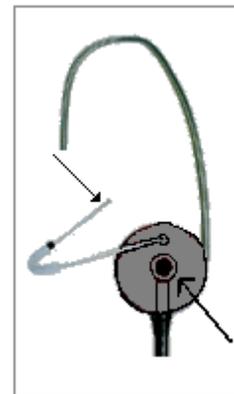
**CALIBRATE THE PROBE TUBE EACH TIME A NEW TUBE IS USED.
IT IS RECOMMENDED YOU USE A NEW TUBE FOR EACH PATIENT.**

From the main menu toolbar, select **Functions/ Calibrate / Probe Tube**.

Follow the instructions to position the tip of the silicon tube against the free field microphone of the probe microphone assembly. Slide the elbow half way along the tube to help hold it in this position. While holding the probe tube assembly from the top of the earhook, hold the assembly half to one (1/2 -1) meter from the loudspeaker at an angle of 90 degrees (duplicating the natural position of the probe microphone assembly as it sits on a patient's ear during testing).

Probe microphone assembly:

The arrows indicate the tip of the probe tube and the free field reference microphone. The tip of the tube needs to rest against the free field reference microphone for calibration of the probe tube.



Click *Start*.

Adjust the speaker volume control on the front of the Avant™ system until a level of 65 dB is reported in the reference level window.

The new curve should closely resemble the stored curve on the screen. If it is significantly different, inspect the probe tube for defects, replace the tube with a new one if necessary and repeat the test.

Special Note: At present , the 3 Dimensional Live Speech Mapping menu is being used for research to develop clinical applications for your use. It is offered in the software for you to experiment with at you convenience.

LESSON TWO

Operating the Avant™ from within NOAH

There are two ways of running the Avant™ software. The first is as a stand-alone program from the desktop. The second, and recommended method, is to run the Avant™ within NOAH.

The advantage of running the Avant™ from within NOAH is the efficiency of performing "real time" real ear measurements while making programming changes to the hearing instrument on the same screen. When you run the Avant™ from within NOAH, the client records are stored in the NOAH database.

Preparation

You need to load your own copy of NOAH to the Avant™, since you are the licensed user of that software.

INSTALLING THE AVANT™ MODULE IN NOAH

The Avant™ module must be installed in NOAH.

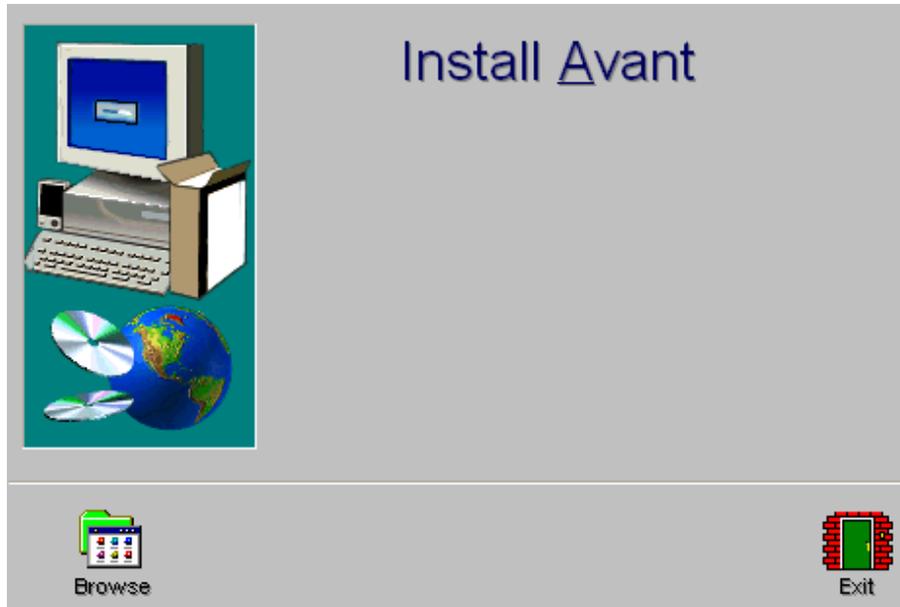
Follow these instructions to install the module.



- From the desktop, open *NOAH*.

- Go to *Tools / Setup / Install Module*.
- Click *Install New Module*.

Insert the MedRx Avant™ software CD into your computer.



- Click the *Browse* icon.

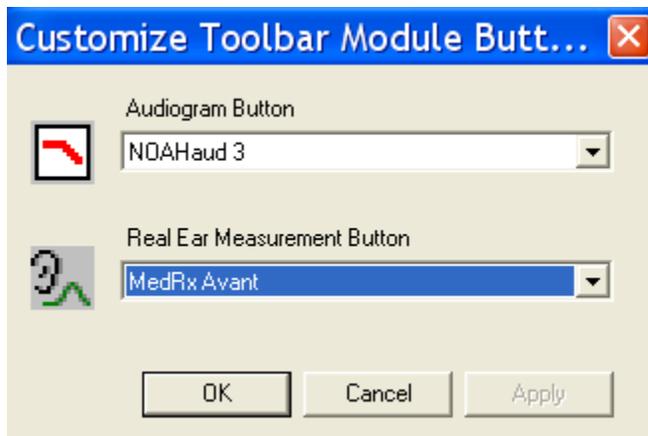
[Or: go to My Computer, click on the D: drive (or your CDrom drive) and Avant(D:) should appear.]

- Click *NOAH* and then click *Install.ini*
- Click *OK*.

CONFIGURE THE NOAH TOOLBAR

To assign the REM icon on the toolbar to the MedRx Avant™, perform the following:

- Go to *Tools / Module Buttons*.
- Click the down arrow icon under the Real Ear Measurement Button heading and select MedRx Avant™.





- Click *OK*.

This assigns the real ear measurement icon on the NOAH toolbar to the Avant TM.

EXERCISE

"REAL TIME" REAL EAR MEASUREMENTS (REM) WHILE SIMULTANEOUSLY PROGRAMMING HEARING INSTRUMENTS.

Preparation

- For the purposes of the following exercise, create a new patient record in NOAH.
- Manually enter an Audiogram

Enter the following audiogram values for the right and left ear:

Air conduction:

20 at 250
30 at 500
40 at 1000
50 at 2000
and 60 at 3000, 4000, 6000 and 8000Hz.

UCL values:

100 at 250
100 at 500
95 at 1000
95 at 2000
90 at 3000,4000,6000 and 8000Hz.

- Save the record.

The New Audiogram appears under the Session summary with a date and time stamp.

- Setup

Pre-program the hearing instrument using the patient's audiometric data as appropriate. Make sure the instruments are connected to the HIPRO cables.

Click *Fitting icon* on the NOAH toolbar.

Select the manufacturer's fitting module and pre-program the hearing instrument.

Save the initial programming in the fitting module.

- Perform an otoscopic inspection of the patient's ear canal.



Click the *real ear measurement* icon on the toolbar.

The Avant TM main menu screen appears.



Click *Pictures*.



Click *Capture*.

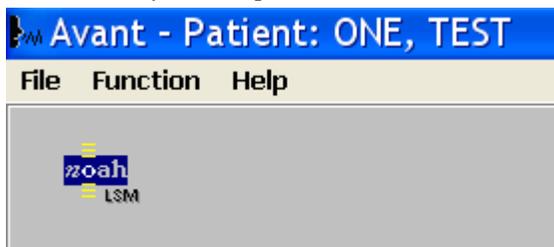
Examine both ears.

To store images to the database, click *Capture* again for each image.

- Insert the probe tube into the patient's right ear canal. Use the VO to assist in placing the probe tube.
- Click *Back* to return to the Avant TM main menu screen.
- With the probe microphone still in the ear canal, insert the patient's hearing aid. Take care not to advance the probe microphone tube further into the ear when you insert the hearing aid.
- Position the patient facing the box loudspeaker at a distance of no more than 3 feet.
- Click the *NOAH LSM* icon on the Avant TM main menu screen.



The LSM screen appears on the display as a small window. This window remains on top of the NOAH screens and can be moved and resized. The client's audiogram data has automatically been imported to the LSM screen.



- Open the hearing aid fitting software from the NOAH toolbar.

Click the *NOAH* icon if you do not have any fitting modules installed or the manufacturer of the hearing instrument you are using for this exercise.

You now have the fitting software on the display, with the Avant TM LSM screen "on-top".

You are now ready to make programming changes to the hearing instrument from the fitting software, while simultaneously monitoring the outcome on the REM LSM display.

NOTE: The "active" window is identified by a bright blue toolbar. An "inactive" window is identified by a pale blue toolbar. To make changes in either the fitting or LSM screen, make sure the window you are clicking in has a bright blue toolbar. To make a window "active", simply click anywhere on that window.

- Turn LSM ON

Click the green circle icon on the toolbar or press Enter on the keyboard to activate Live Speech Mapping. A real-time Live Speech Map is displayed on the screen.

To stop LSM, click the red circle icon on the tool bar or press Esc on the keyboard.

See the Lesson on Live Speech Mapping for exercises to be completed for Hearing Instrument Fitting Verification.

Other signal input types for LSM:

In addition to using Live Speech to measure aided performance, other input stimuli options are available in LSM.

On the LSM toolbar, click **Stimulus | MIC; Music File; CD Player; Pink Noise (PN); Speech Noise(SN) or White Noise(WN).**

MIC is the default LSM mode and uses input to the probe reference microphone allowing you to use your own voice or third party's voice as the input signal.

The Avant TM produces SN, PN and WN from the speakers. The input level is monitored by the VU meter. Adjust the speaker output by changing the dB level on the software or the hardware speaker adjustment control on the Avant TM.

SAVING THE FITTING AND LSM DATA

When you are satisfied with the hearing instrument fitting, you need to save the fitting settings and the LSM curves.

SAVE AND CLOSE THE NOAH FITTING MODULE FIRST.



- When the fitting module is closed, click the *real ear measurement* icon on the NOAH toolbar.

This opens the Avant™ LSM screen to full size.



Back

- To save the NOAH session, click *Back*.



- Click *Exit*.

The NOAH Sessions summary now lists a Fitting record and MedRx REM record.

VIEWING SAVED SESSIONS IN THE NOAH DATABASE

To view the REM LSM data, click on the MedRx REM session from the Sessions list in NOAH.



- Click the *real ear measurement icon* on the NOAH toolbar.



- Click *LSM*.

The stored curves are automatically displayed on the LSM screen.

LESSON THREE

AUDIOMETRY

This lesson shows you how to perform pure tone audiometry using the Avant™.

EXERCISES

EXERCISE ONE: SETTING UP THE AUDIOMETER SOFTWARE

EXERCISE TWO: HOW TO PERFORM AUDIOMETRY

EXERCISE THREE: OBTAINING DISCRETE FREQUENCY UCLS

EXERCISE FOUR: REMOVING UNWANTED DATA FROM THE AUDIOGRAM

EXERCISE FIVE: CUSTOMIZING AUDIOMETRY

Preparing for Exercise One

There are two ways of operating the Avant™ software. The first is as a stand-alone program from the desktop. When you use the Avant™ from the desktop, data is not stored to the NOAH database.

The preferred operation is to run the Avant™ from within NOAH after you have installed the Avant™ measurement module in NOAH. (Lesson One)

Operating the Avant™ from within NOAH:

Lesson Eight provides exercises in how to setup and operate the Avant™ from within NOAH.

- Open *NOAH* from the desktop.

Open the patient's folder (Client).

- Click the *real ear measurement module* icon on the toolbar.

The Avant™ main menu appears on your screen.

EXERCISE ONE: SETTING UP THE AUDIOMETER SOFTWARE

- Click *Audio* from the main menu screen to enter Audiometry.

- Click *Help*. Read the Tone Audiometry help topic and follow the link to Audiometry Control Panel icons.



Audio

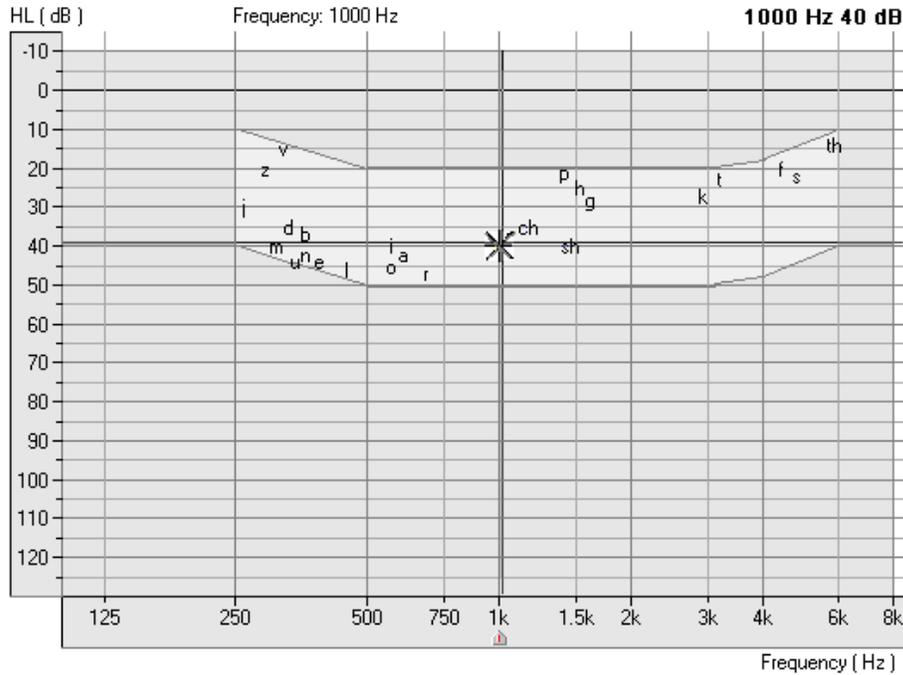


Help

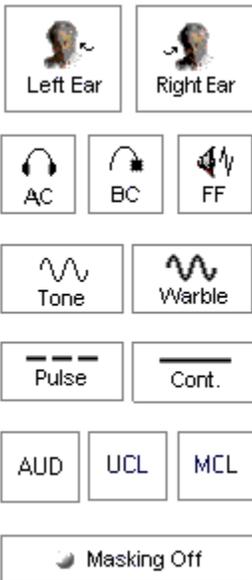
Close the Help screen by clicking the X icon at the top right corner of the screen.

Understanding the Audiometry display:

The yellow asterisk symbol on the audiogram lets you know the test level and frequency the audiometer is currently set to. This information is also obtained by noting the Test dB attenuator level on the control panel and the arrow icon below the audiogram indicates the test frequency.



Audiogram



The speaker icon, located under the attenuator control bars, lets you know when a tone is on or off.



The Audiometry control panel is designed for one icon to be selected in each row. The default settings are: Right Ear, Air Conduction, Tone, Continuous and AUD. If you prefer to start testing with a different setup, simply click on the desired icon on the control panel.

For example: To change from Air Conduction (AC) to Bone Conduction (BC), click the BC icon.

To change from threshold testing to either discrete frequency MCL or UCL testing, click on the MCL or UCL icon respectively.

The *Masking OFF/ON* icon toggles between OFF and ON with each click on the Masking icon. The icon text indicates the current status. If the icon says Masking On, then masking noise is ON. To turn it off, click on the Masking icon and it will change to Masking OFF.

To set the Test Level:

There are a few methods to control the test level attenuator in Audiometry. Some methods use the mouse only, while others use the keyboard. A special Audiometer keyboard, with attenuator knobs, is also an available option.

Practice each option below and find the one you prefer.

- Option One

Point the mouse to the *arrow* icon on the Test dB attenuator bar. Click and hold down the left mouse button on the arrow icon and drag it to the desired test level and release the mouse button.

- Option Two

Click the -5 or +5 icon to change the attenuator in 5dB steps in the corresponding direction.

- Option Three

Click anywhere on the *Test dB* attenuator bar to get a dashed box around the bar. This has activated the keyboard controls of the attenuator. Press the up or down arrow key on the keyboard to step the attenuator up or down. The default step size is up 5dB and down 10dB. The screen attenuator and asterisk symbol on the audiogram are automatically updated each time the arrow keys are pressed.

- Option Four

Click on the *Up arrow* or *Down arrow* icons below the Test dB attenuator. Each click steps the attenuator in the appropriate corresponding arrow direction. The default step sizes are up 5dB and down 10dB.

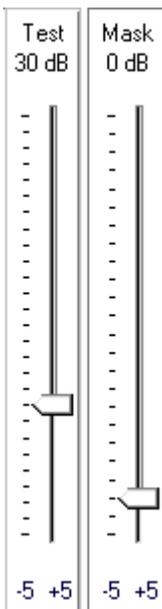
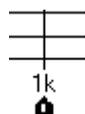
Note: The default step size for the arrow icons and keyboard arrow keys can be customized under **Options | Audiometry**. (See Exercise Five in this lesson)

- Option Five

Using the special Audiometer keyboard, simply turn the right attenuator dial in a clockwise direction to increase the test level, and anti-clockwise to decrease the test level.

To set the test Frequency:

- Option One



Press the Left or Right arrow key on the keyboard to step the desired test frequency. The arrow icon under the Audiogram indicates the current test frequency. The yellow asterisk on the Audiogram will also track to the new frequency selected.

- Option Two

Point the mouse to the desired test frequency script under the Audiogram and click on that frequency. The *arrow* icon will snap to this new frequency.

Practice this option: Point and click the mouse to the text *2k* under the audiogram. The arrow icon will snap to 2k.

Patient Response



If the patient is using the handswitch, the green patient response icon will highlight on the display when the button on the handswitch is pressed.

No Response



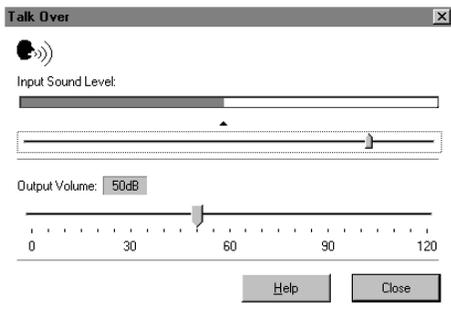
To indicate a patient did not respond to the maximum output of the audiometer for that frequency, click *No Response*. The appropriate No Response symbol is recorded on the audiogram.

How to use Talkover



Click *Talkover*.

Position your talkover microphone. The microphone needs to be close to your mouth and maintained at a constant distance from your mouth while in use.



Speak at a normal level and calibrate the Input Sound Level to the microphone by sliding the *arrow* icon until the blue line on the VU meter just meets the calibration marker. When you see the VU meter line go past this marker, the line will be red. In this case, you have adjusted it too high.

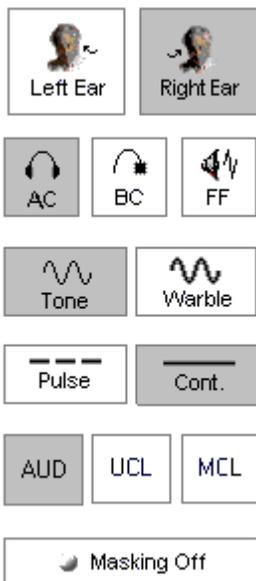
The output to the patient can now be set to the desired decibel level using the Output Volume control. Click and hold the mouse button on the *arrow* icon and drag it to the volume needed for the patient to hear you through the insert earphones. Click *Close* to turn the talkover microphone off.

LOCK MASKING LEVEL TO THE TEST LEVEL



When masking, it is sometimes useful to determine a minimum masking level for a test level and then “lock” the masking attenuator to change with the test level. To do this, first set the attenuator to the test level and then determine the minimum effective masking level needed in the non-test ear and set the mask attenuator to this level. Now click the *Lock* icon and *Masking On*. All you have to do now is adjust the test level attenuator to find the masked threshold. The masking level will automatically adjust to the new test level as you seek threshold.

EXERCISE TWO: HOW TO PERFORM AUDIOMETRY



Back

Assumption: It is assumed you know how to perform audiometric testing for obtaining air and bone conduction thresholds using pure tones.

It is most useful to perform and practice this exercise on someone from your office. Make sure the test environment is quiet and you have all the audiometric hardware connected to the Avant™. Refer to the installation manual if necessary.

Setup the control panel for pure tone audiometry:

- *Right Ear, AC, Tone, Continuous and AUD.*
- Set the Test Level attenuator to 40dB.
- Set the test frequency to 1000Hz.
- Perform an Otoscopic examination of the ear canals. Activate the video otoscope preview mode by clicking the *camera* icon on the taskbar. Inspect each ear canal in the live mode.
- Click *Back* to return to Audiometry.
- Instruct the patient in the task and how to respond to the tones.
- Place the insert earphones in the patient's ear canals, ensuring an adequate insertion depth.
- Present the first tone using your preferred method of presentation.

Monitor the patient's response and adjust the attenuator accordingly. You will notice the right AC symbol (O) is automatically recorded to the audiogram.

- Search for hearing threshold.

When threshold is found, move to 2000Hz and find threshold. Each time you move to a new test frequency, the threshold for the previous frequency is automatically stored to the audiogram.

Test 1000,2000,3000,4000,8000, 500 and 250Hz.



When all the thresholds are obtained for the test frequencies required for the first ear, click *Left Ear* and repeat the procedure for the left ear.

Bone Conduction

- Click *Bone Conduction*.

Place the bone conductor on the poorer air conduction threshold ear. Remove the insert earphones.

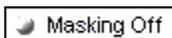


Practice finding BC thresholds for 1000, 2000, 4000 and 500Hz.

Use the same technique to find threshold as used in air conduction testing.

The appropriate bone conduction symbol is automatically plotted to the audiogram.

Masking



When masking is required, click *Masking Off* to turn the masking narrow band noise on. The icon will now indicate Masking ON. Masking noise automatically routes to the non-test ear. Therefore, if you are testing right bone conduction and you select Masking, the masking noise automatically routes to the left insert earphone. Remember to place the air conduction insert earphone in the non-test ear for masking.

Set the masking level by adjusting the Mask level attenuator.

Turn masking off by clicking the *Masking On* icon. The icon will now say Masking OFF.

EXERCISE THREE: OBTAINING DISCRETE FREQUENCY UCLs



- To record discrete frequency UCLs, select *AC*, *Tone*, *Continuous* and *UCL* on the control panel.

Carefully instruct the patient in the task. The patient needs to know you will gradually turn the tone up until it momentarily reaches an uncomfortable level. This critical information is of great benefit in the hearing aid fitting.

Use the attenuator and tone presentation controls to gradually increase the tone until the patient indicates you have reached uncomfortably loud.

Find discrete frequency UCLs for as many frequencies as possible.

NOTE: Be aware that when you change test frequency, you will need to turn the attenuator down a little to begin testing. Otherwise, your first tone presentation will be close to UCL, which will startle the patient.

The symbol for UCL (U) is automatically recorded on the audiogram. A blue U reports the left ear UCL and a red U reports the right ear UCL.

EXERCISE FOUR: REMOVING UNWANTED DATA FROM THE AUDIOGRAM



To remove a whole curve, click the icons on the control panel corresponding to the data you want to remove. For example: click left ear, AC, AUD. Click *Discard*. All the left ear, air conduction values will be removed from the audiogram.

To remove discrete data points on the audiogram point the mouse to the unwanted value on the audiogram and right click the mouse button. This removes only a single data point on the curve.

Oops! I deleted the wrong data? How do I retrieve it?

Go to *Tools* on the toolbar and select *Undelete*.

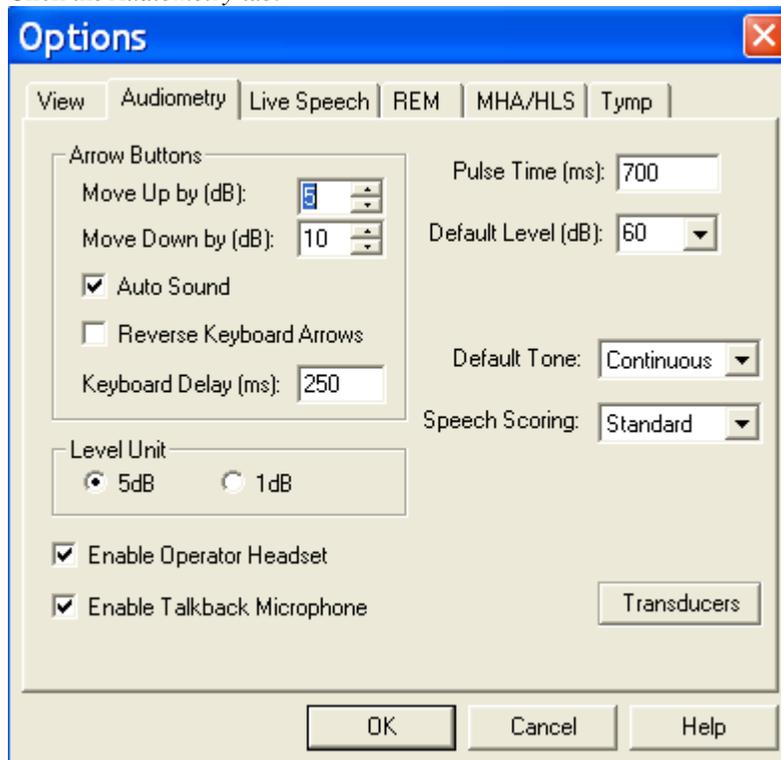
EXERCISE FIVE: CUSTOMIZING AUDIOMETRY

There are several ways to customize the Audiometry setup to suit your preferences. All customizing features are accessed from *Options* on the toolbar.

From the toolbar, go to **Options | Audiometry**.

Set the Default Ear to your preferred first ear to test.

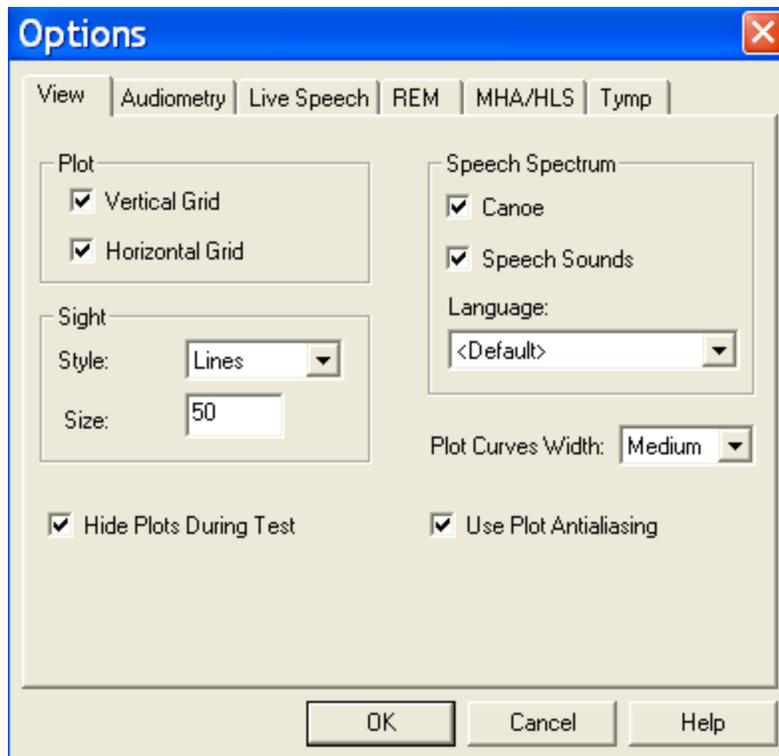
Click the *Audiometry* tab.



Features you can customize include: arrow icons (step size); Autosound; reverse keyboard arrows; Keyboard delay time; pulse time; default level; talkback level; enable operator headset and talkback microphone; Level increments; speech scoring (UK); default Tone and control of multimedia speakers.

Click *Help*. Read the description of all the audiometry properties. Close Help and make any changes to the setup to customize to your preferences.

Click the *View* tab. Properties you can customize include: speech spectrum - canoe and speech sounds; Plot curve width - thick, medium and thin. A check mark in the white box indicates the canoe or speech sounds will appear on the audiogram.



LESSON FOUR

SPEECH TESTING

Speech testing provides information about the accuracy of the audiogram in addition to an indication of how well a patient may do with amplification.

The two most common speech tests performed in a hearing evaluation are the Speech Reception Threshold (SRT) and Discrimination Score (DS) test (also known as Word Recognition tests).

EXERCISES

EXERCISE ONE: HOW TO FIND SPEECH RECEPTION THRESHOLD USING THE DYNAMIC WORDLIST FEATURE

EXERCISE TWO: USE THE CD PLAYER FOR SPEECH TESTING

EXERCISE THREE: FIND MCL FOR SPEECH

EXERCISE FOUR: OBTAIN A DISCRIMINATION SCORE AT MCL

EXERCISE FIVE: FIND UCL FOR SPEECH

Setup for Exercises

Open a patient record with audiometric data or continue with the patient record used in lesson One.



- Click *Audio* on the main menu.

EXERCISE ONE: HOW TO FIND SPEECH RECEPTION THRESHOLD USING THE DYNAMIC WORDLIST FEATURE

In addition to being a convenient method for the clinician, the Wordlist feature also involves a third party in the speech testing process. This feature allows the third party to see the speech test words "flash" on the screen before hearing the patient's response. This process provides real time counseling on how the hearing loss effects understanding speech.

SRT

- Click *SRT* on the Audiometry taskbar.

The Pure Tone Average (PTA) for each ear is displayed above the legend in the lower left of the screen. This assists you in determining your starting level for SRT determination.

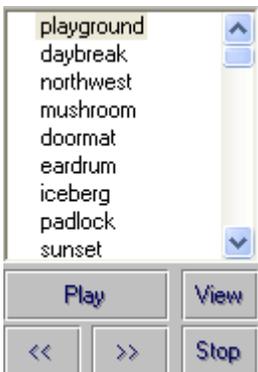
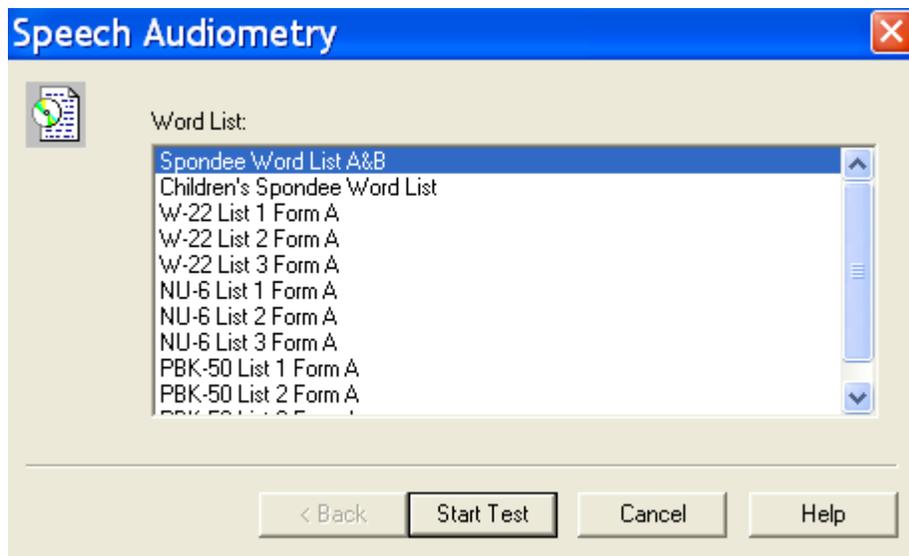


- Click the *Help* icon. Read the help topic for Speech Test Screen and become familiar with the SRT display and icons before proceeding with this exercise. Follow any link for further details.
- Close the Help file to return to the SRT display.



Setup for Wordlist:

- Click *Right Ear*.
- Click *File* on the control panel.
- Click *Wordlist*.
- Click *Spondee Wordlist A & B*.

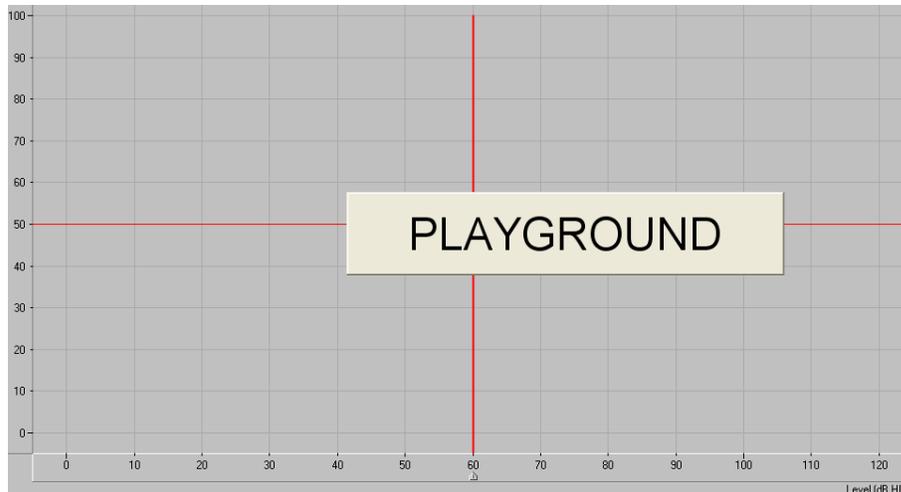


- Click *Start Test*.

The Spondee wordlist now appears on the speech test control panel with the first word highlighted.

With the third party watching the screen, present the first word. To present the first word, click *Play* on the wordlist control panel or press *F9* on the keyboard.

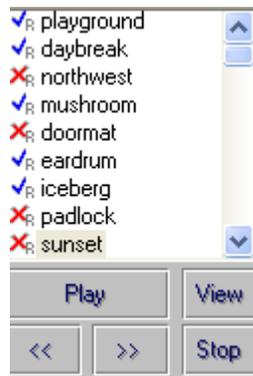
The test word "flashes" on the screen.



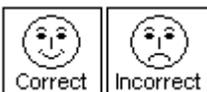
Listen to the patient's response.

- Score the patient's response using either the *Correct* or *Incorrect* icons or the *F7* for correct or *F8* for incorrect.
- Present each successive word on the list, scoring each response. Click the *forward* (>>) icon or press *F10* on the keyboard to move to the next word.

The test word is marked with a check or cross corresponding with the response provided.



Scoring



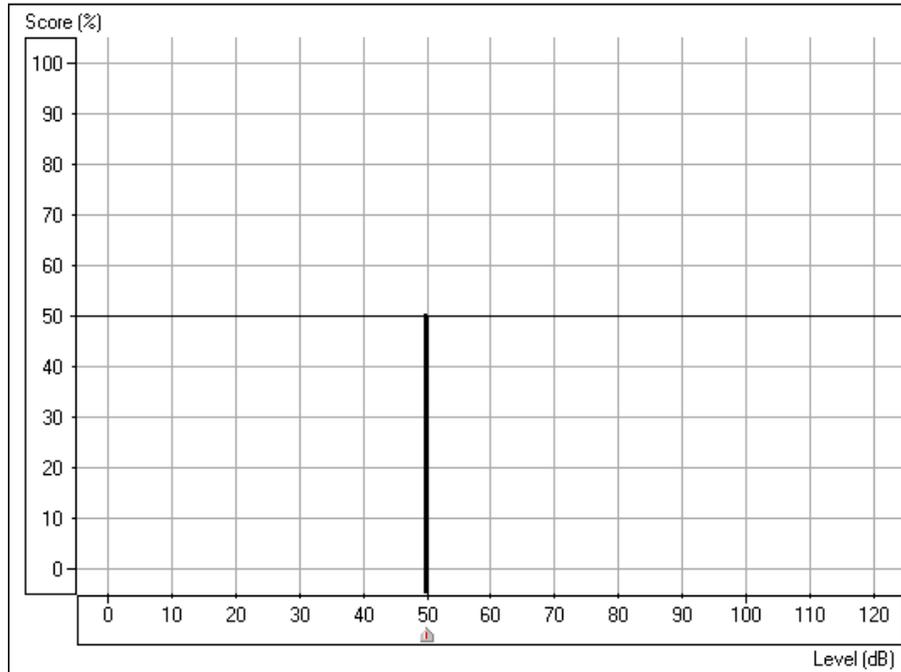
You can either use the mouse or keyboard to score the patient's response. Use the mouse to click the *Correct* or *Incorrect* icon for each response or press *F7* for *Correct* and *F8* for *Incorrect* on the keyboard.

The total score is updated automatically each time a response is scored as *Correct* or *Incorrect*.

Score:	50%
Total:	6
Correct:	3
Incorrect:	3

In this example, six words were presented at the current test level. Three responses were correct and three were incorrect for a Score of 50%.

The SRT display shows a "dynamic" vertical line on the grid to show percentage correct at the current test level



In this example, the SRT score of 50% is recorded at 50dB.

Your aim in SRT testing is to find the lowest level at which the patient scores 50% correct. Adjust the test level as required to find this level. Each time you change the test level, the score automatically resets to zero.

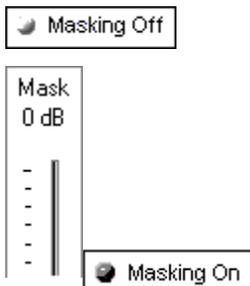
For example: Present the first 4 spondees. If the score is 75%, lower the presentation level and present another 4 words. If the score is now 25%, increase the presentation level and present more words. Continue to do this until you find the lowest level at which the patient scores 50%.



When SRT is determined for the right ear, click *Left* Ear and continue with the next word on the list. Use the PTA for the left ear to select a new start test level before presenting the next word.

Click *Stop* on the wordlist control panel to end the test. The word list is removed from the display.

MASKING



When masking is required, click *Masking Off* to turn the masking narrow band noise on. The icon will now indicate Masking ON. Masking noise automatically routes to the non-test ear. Therefore, if you are testing right bone conduction and you select Masking, the masking noise automatically routes to the left insert earphone. Remember to place the air conduction insert earphone in the non-test ear for masking.

- Set the masking level by adjusting the Mask level attenuator.

Turn masking off by clicking the *Masking On* icon. The icon will now say Masking OFF.

LOCK MASKING LEVEL TO THE TEST LEVEL

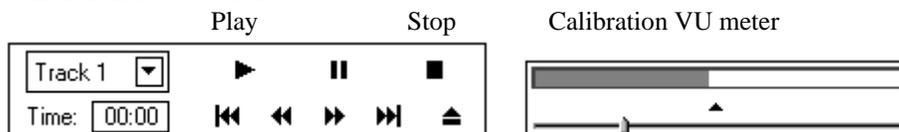
When masking, it is sometimes useful to determine a minimum masking level for a test level and then “lock” the masking attenuator to change with the test level. To do this, first set the attenuator to the test level and then determine the minimum effective masking level needed in the non-test ear and set the mask attenuator to this level. Now click the *Lock* icon and *Masking On*. All you have to do now is adjust the test level attenuator to find the masked threshold. The masking level will automatically adjust to the new test level as you seek threshold.



EXERCISE TWO: USE THE CD PLAYER FOR SPEECH TESTING

An alternative to using the material on File and the Wordlist function is to use CD recorded material.

- Insert the wordlist CD into the CD ROM. (Auditec CD)
- Click *CD*.
- To calibrate the CD, click *Play* on the CD control panel. The first track on the CD is a 1kHz calibration tone. Look at the VU meter at the top of the display. The blue line on the VU meter needs to peak at the arrow marker. Adjust the level by dragging the *arrow* icon to the left or right as needed. Click the *Stop* icon on the CD control panel when calibration is successful.



- Click *Right Ear* and *AC*.
- Set the *Test dB* to the desired starting level.

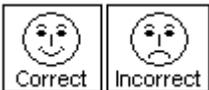
- Select *Track 2* on the CD. *Track 2* is *Adult Spondees*.
- Instruct the patient and insert the earphones.

Finding SRT



- To start the test, click either *Play* on the CD control panel or *Signal OFF* icon. *Signal OFF* toggles to *Signal ON* when it is selected. These two controls operate interchangeably. *Play* is the same as *Signal On* and *Stop* is the same as *Signal Off*.
- Monitor the test word by tracking the printed wordlist or by using the monitoring headset. Adjust the volume control to a comfort level when using the monitoring headset.
- Monitor the patient's response. If you are using a two-way sound booth, you will have a talkback system in place to monitor the patient's response.

Scoring



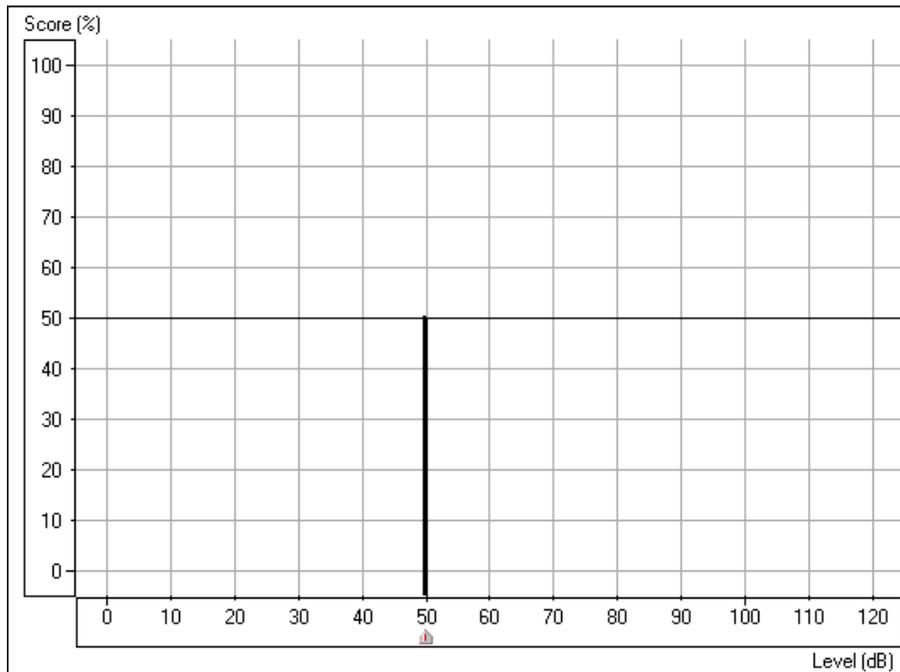
You can either use the mouse or keyboard to score the patient's response. Use the mouse to click the *Correct* or *Incorrect* icon for each response or press F7 for *Correct* and F8 for *Incorrect* on the keyboard.

The total score is updated automatically each time a response is scored as *Correct* or *Incorrect*.

Score:	50%
Total:	6
Correct:	3
Incorrect:	3

In this example, six words were presented at the current test level. Three responses were correct and three were incorrect for a *Score* of 50%.

The *SRT* display shows a "dynamic" vertical line on the grid to show percentage correct at the current test level

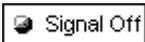


In this example, the SRT score of 50% is recorded at 50dB.

Your aim in SRT testing is to find the lowest level at which the patient scores 50% correct. Adjust the test level as required to find this level. Each time you change the test level, the score automatically resets to zero.

For example: Present the first 4 spondees. If the score is 75%, lower the presentation level and present another 4 words. If the score is now 25%, increase the presentation level and present more words. Continue to do this until you find the lowest level at which the patient scores 50%.

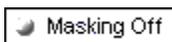
Use the *pause* icon on the CD control panel while you change the test level. You will not need to do this once you have practiced SRT testing as you will find you have adequate time between words to change the test level without pausing the CD.



- Click *Stop* or *Signal Off/On* when the test is complete.

Find SRT for the other ear.

MASKING



When masking is required, click *Masking Off* to turn the masking narrow band noise on. The icon will now indicate Masking ON. Masking noise automatically routes to the non-test ear. Therefore, if you are testing right bone conduction and you select Masking, the masking noise automatically routes to the left insert earphone. Remember to place the air conduction insert earphone in the non-test ear for masking.

Set the masking level by adjusting the Mask level attenuator.



Turn masking off by clicking the *Masking On* icon. The icon will now say Masking OFF.

LOCK MASKING LEVEL TO THE TEST LEVEL

When masking, it is sometimes useful to determine a minimum masking level for a test level and then “lock” the masking attenuator to change with the test level. To do this, first set the attenuator to the test level and then determine the minimum effective masking level needed in the non-test ear and set the mask attenuator to this level. Now click the *Lock* icon and *Masking On*. All you have to do now is adjust the test level attenuator to find the masked threshold. The masking level will automatically adjust to the new test level as you seek threshold.



OPTIONAL ACTIVITY:

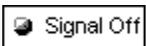
Setup for Microphone (live voice) presentation mode



- Click *Right Ear, AC* and *Mic*.

Position the microphone close to your mouth.

- Set the *Test level* attenuator to 0dB.



- To calibrate the microphone, click *Signal Off /On* icon. Speak at a normal voice level. It is useful if you repeat a spondee a few times over. Monitor the speech VU meter at the top of the display. The maximum energy of the spondee should peak at the calibration marker, where the blue line meets the red line. Adjust the VU meter using the *arrow* icon on the meter until the level is calibrated.



- When you have calibrated the microphone, click *Signal Off/On* to turn the microphone off until you are ready to test. The icon should now display Signal Off.

Set the start level on the Test dB bar. You can use the PTA under Tools to guide you in deciding what level to start the test.

Click *Signal Off/On* when you are ready to present the first word. Remember to monitor your voice level on the VU meter and make sure you peak at the calibrated level. Score each patient response as correct or incorrect using the appropriate mouse or keyboard options.

Find SRT for each ear.

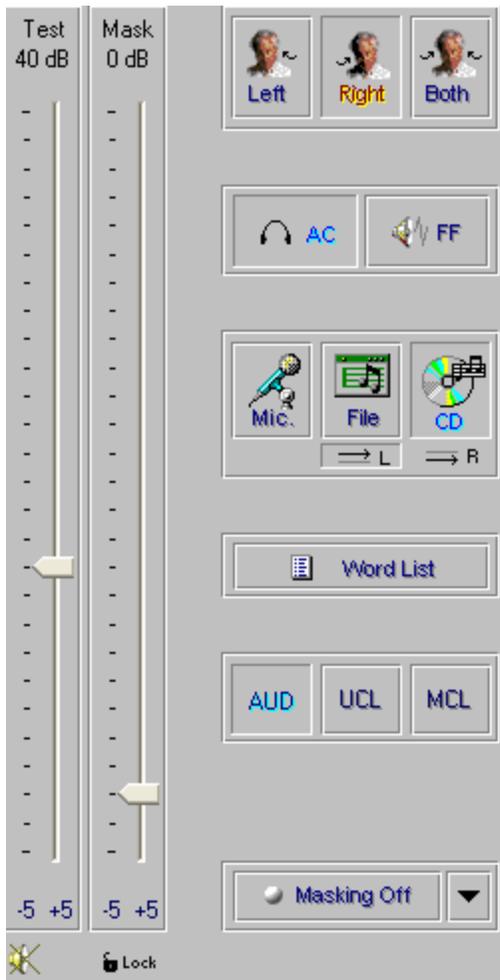
Turn the microphone off by selecting the *Signal ON /Off* icon to end testing,

EXERCISE THREE: FIND MCL FOR SPEECH



- Click *Discrimination Score* on the Audiometry taskbar.
- Click *Help*. Read the help file on Discrimination Score. Become familiar with the task description, display and icons used in this test.
- The Discrimination Score control panel has three icons that are not used in SRT. These are the AUD, UCL and MCL icons. These icons are used to ensure the appropriate symbol is recorded on the display to represent a discrimination score, the UCL level or the MCL level.

You will need to find the patient's Most Comfortable Level (MCL) for speech material before obtaining a discrimination score.



Setup for finding MCL using the Auditec CD

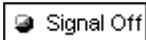
- Click *Right Ear, AC, CD, MCL*.

Insert the speech CD into the CD-rom.

- Set the *Test level* dB attenuator to 40dB.

- Select Track 14 on the CD control panel. This track plays continuous discourse, which is the preferred material for finding MCL.

Instruct the patient. Carefully explain to the patient that you will turn the volume up gradually. The patient needs to tell you when they can hear the voice at a comfortable level, similar to their preferred volume for the radio or television.



- Click *Signal Off/On* icon or *Play* on the CD control panel.
- Gradually increase the volume and monitor the patient's response. Choose one of the three methods to adjust the attenuator: Use the up arrow key on the keyboard or click the *arrow* icon on the attenuator bar or hold the mouse button down and drag the *arrow* icon slowly up the attenuator Test dB bar.



Look for the MCL (M) symbol on the bottom of the Discrimination Score results grid as it tracks with the attenuator.

When your patient indicates you have reached MCL, select the *pause* button on the CD player.



- Click *Left Ear* and find MCL for the left ear.

You have now obtained the patient's speech MCL for each ear.

BINAURAL MCL



- To find binaural MCL, click the *Both* icon.
- Set each attenuator, Left and Right, to 5dB below the monaural MCL dB level determined previously.
- Present Track 14 in the same manner as for monaural MCL, and adjust the Left and Right attenuators according to the Patient's perceived comfortable level.

Note: If you intend on finding a discrimination score at the patient's MCL, you may wish to stay with the right ear before switching to the left ear to find MCL. The next exercise takes you through the steps to obtaining a discrimination score at MCL.

EXERCISE FOUR: OBTAIN A DISCRIMINATION SCORE AT MCL

It is useful to obtain a score of speech discrimination or word recognition at the patient's most comfortable listening level. The result provides an idea of how well the patient may do with amplification.

Setup

USING THE DYNAMIC WORDLIST PRESENTATION MODE

- Setup the control panel by selecting *Right, AC, File* and *AUD*.
- Set the attenuator to the desired level.
- Click *Wordlist*.
- Select the Word list preferred, and *Start Test*. Example: select NU 6 or W22 wordlist.



Instruct the patient. Make sure you can hear the patient's response, whether you use a one room or remote microphone setup.

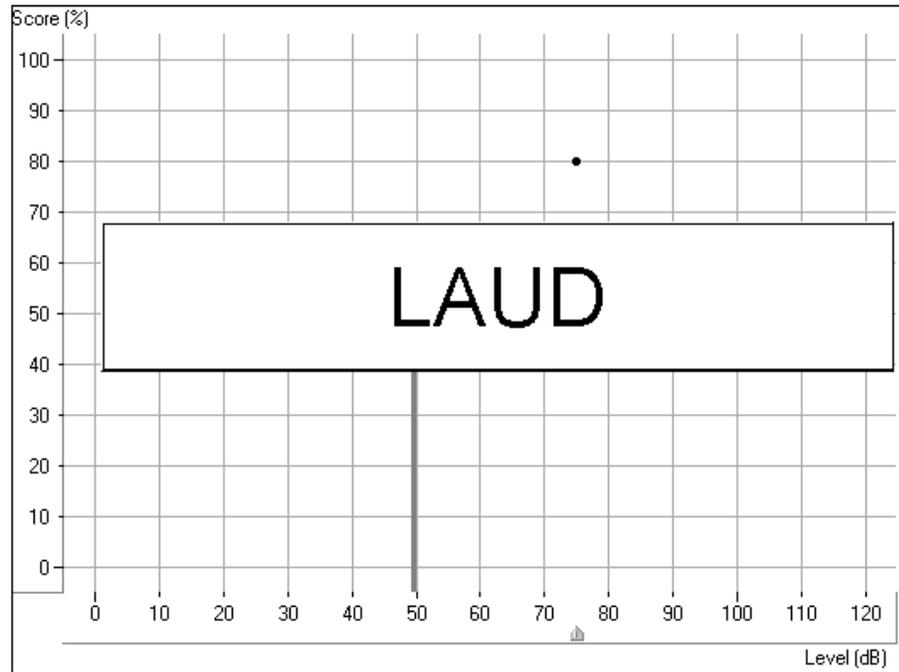
Make sure the insert earphones are inserted appropriately.

Note: If a third party is present, you may wish to use the Dynamic Wordlist presentation mode to present the test words. A special section at the end of this exercise steps you through this option. For now, follow the steps as described below.



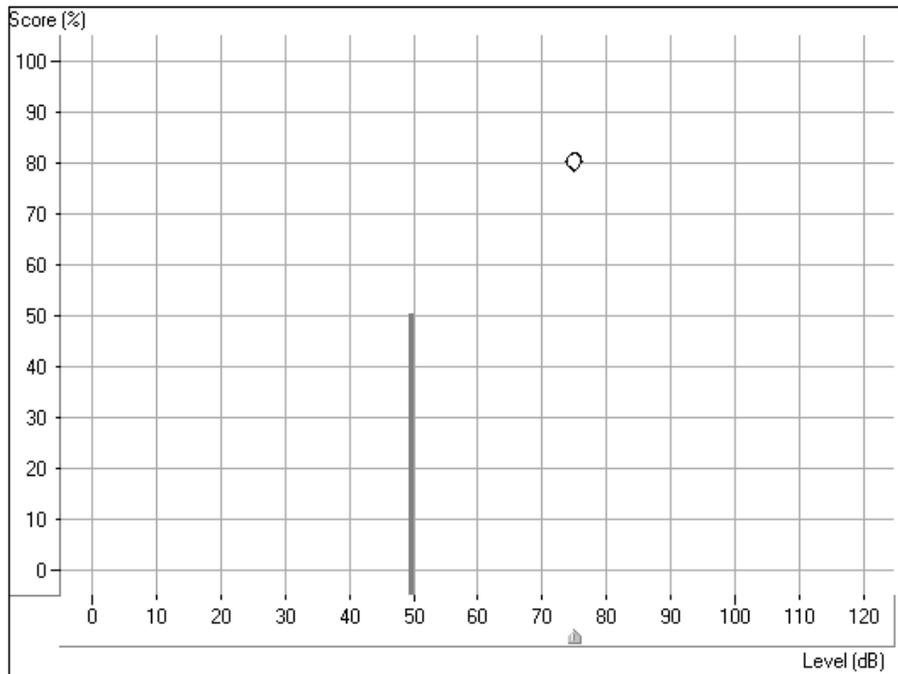
- Click *Play* on the Wordlist control panel or press the *F9* key on the keyboard to present the first word.

The word appears in large text at the center of your screen.



- Score the patient's response as correct or incorrect, using either the *Correct* or *Incorrect* icons or the *F7* or *F8* keys respectively.

The score is automatically plotted to the display and is continuously updated for each response. The score indicates the percentage correct at the test level.



In the above example, a discrimination score of 80% was obtained at a test level of 75dB. The solid vertical line at 50dB represents the SRT for the same ear.

You can also monitor the status summary textbox under the control panel. This reports the current score, total number of words presented, number correct and number incorrect.

Score:	80%
Total:	20
Correct:	16
Incorrect:	4



- Click *forward* or press *F10* on the keyboard to present each successive word on the list. Remember to score each response to a test word.

Present the desired number of words to obtain a Discrimination Score.

- When the desired number of words has been presented, click *Stop* on the Wordlist control panel.

At this point, you may want to present more words at a new test level. Set the attenuator to the new level and click *Play* to proceed. A new score is obtained for the new test level.



- Repeat the procedure for the Left ear.
- Click *Stop* to end the wordlist test and return to the default control panel display.

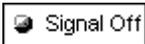
USING CD RECORDED MATERIAL FOR DS TESTING

- Click *Right*, *AC*, *CD* and *AUD*.
- Set the attenuator to the MCL level determined in the preceding exercise.
- Select your preferred wordlist on the CD control panel. Refer to the inside cover of the speech CD to locate the list of your preference.

Instruct the patient. Make sure you can hear the patient's response, whether you use a one room or remote microphone setup.

Make sure the insert earphones are inserted appropriately.

Note: If a third party is present, you may wish to use the Dynamic Wordlist presentation mode to present the test words. A special section at the end of this exercise steps you through this option. For now, follow the steps as described below.

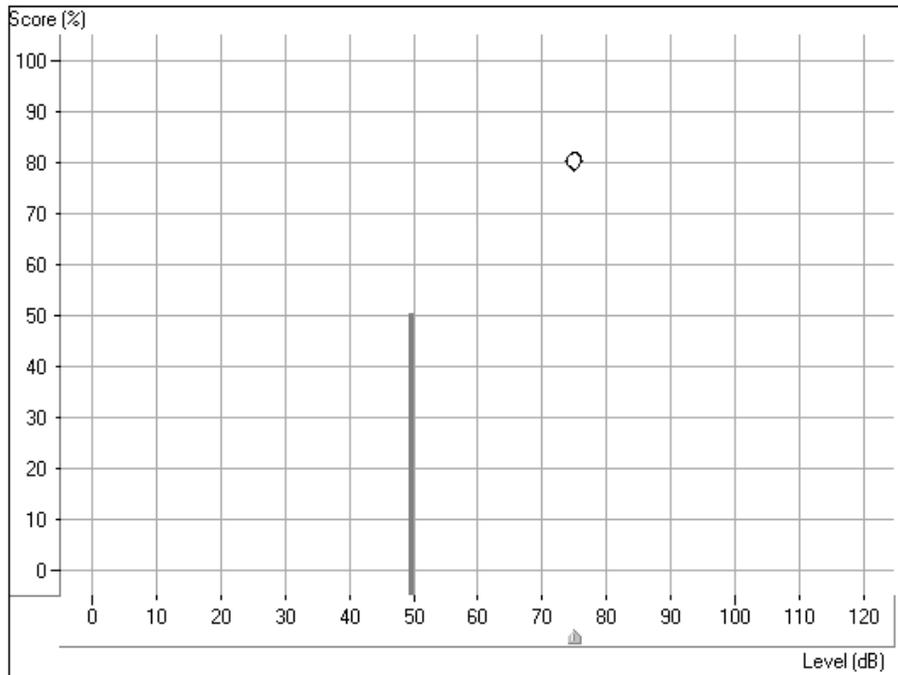


- Click the CD control *Play* icon or *Signal Off/On* to start the test.

Monitor the test words by tracking the printed list of words or use the monitor headset.

- Score each response. Click *Correct* or *Incorrect* or use the keyboard keys F7 for correct and F8 for incorrect.

The score is automatically plotted to the display and is continuously updated for each response. The score indicates the percentage correct at the test level.



In the above example, a discrimination score of 80% was obtained at a test level of 75dB. The solid vertical line at 50dB represents the SRT for the same ear.

You can also monitor the status summary textbox under the control panel. This reports the current score, total number of words presented, number correct and number incorrect.

Score:	80%
Total:	20
Correct:	16
Incorrect:	4

When the desired number of words has been presented, click *pause* on the CD control panel.



At this point, you may want to present more words at a new test level. Set the attenuator to the new level and click *Play* to proceed. A new score is obtained for the new test level.

When you have finished with the right ear, repeat the procedure for the *Left* ear.

BINAURAL DISCRIMINATION SCORE



- To obtain a binaural discrimination score, click the *Both* icon.
- Adjust both the left and right attenuators to the desired input levels.

- Select the wordlist track to be presented.

Score the patient's responses in the same manner as described in the previous monaural discrimination score task.

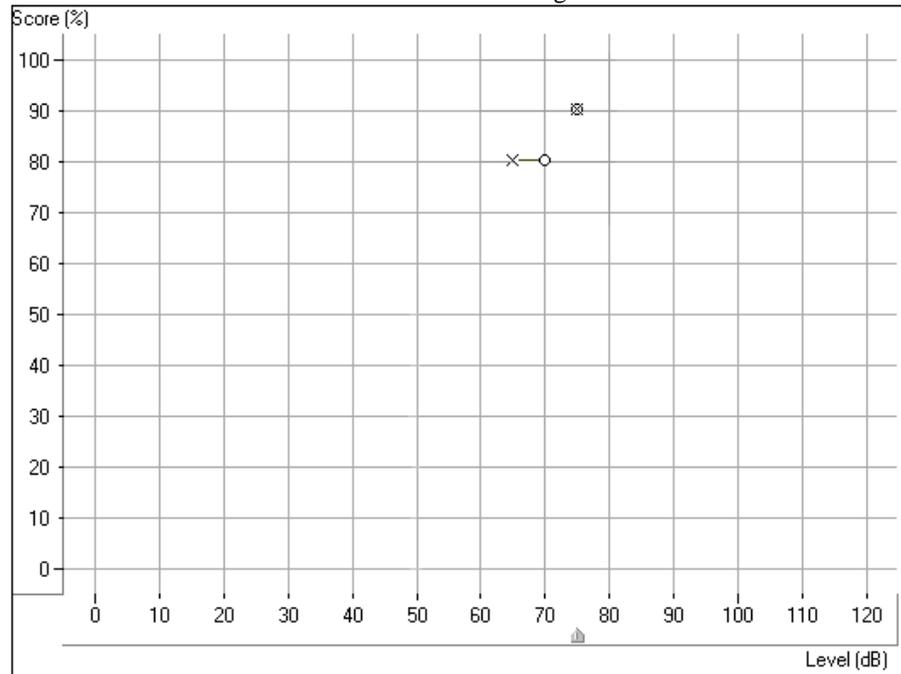
The test results are plotted to the grid in the following manner:

A red circle indicates the test level in the right ear and a blue cross shows the test level in the left ear.

The results in the diagram below are:

90% score at 75dB in both the right and left ear

80% score at 65dB in the left ear and 70dB in the right ear.



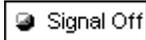
EXERCISE FIVE: FIND UCL FOR SPEECH

While obtaining discrete frequency UCL data using pure tones is highly recommended in Audiometry, it is sometimes useful to obtain a UCL using speech material.

Setup for UCL



- Click *Right Ear, AC, UCL* and *CD*.
- Select Track 14 on the CD (continuous discourse)
- Set the attenuator to the patient's MCL.



Instruct the patient carefully. Explain to the patient that you will turn the volume up gradually. The patient needs to tell you when they can no longer tolerate the sound, even for a few seconds. Look for the "crows feet" to appear around the patient's eyes.

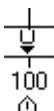
- Click *Play* on the CD control panel or *Signal Off/On* icon.

Gradually increase the attenuator level until the desired UCL response is obtained.

Choose one of the three methods to adjust the attenuator: Use the up arrow key on the keyboard or click the *arrow* icon on the attenuator bar or hold the mouse button down and drag the *arrow* icon slowly up the attenuator Test dB bar.



- **Immediately** click the *Stop* icon on the CD control panel or the *Signal On/Off* icon when the patient indicates UCL.



The UCL level is indicated on the display as a U symbol below the discrimination score results grid.

SUMMARY

Is there an easy way to view all the speech test results?

A summary of the speech test results is displayed on the Audiometry screen.

- Click *Audiometry* on the taskbar.

At the bottom of the screen, the speech test results are displayed in the following table:

	SRT	DS	MCL	UCL
Left:	45dB	94% at 75dB	75dB	100dB
Right:	50dB	87% at 70dB	75dB	100dB
Both:	45dB	87% at 75dB	75dB	95dB

Note: The "best" scores are imported to this summary box.

LESSON FIVE

LIVE SPEECH MAPPING

In almost all cases, the primary reason for fitting a hearing aid is to improve speech understanding. It stands to reason that we must then use **speech** to evaluate and verify a hearing aid fitting.

Live Speech Mapping is the most useful demonstration of how much “normal” or “soft” speech is inaudible to the unaided ear. When a hearing instrument is fitted, Live Speech Mapping clearly shows how soft, moderate and loud input speech input levels fit in the patient’s dynamic range of hearing.

Background

WHAT ARE REAL EAR MEASUREMENTS (REM)?

Real ear measurements are measurements of sound obtained with a probe tube microphone placed at the eardrum of the patient, therefore taking into account the specific external ear resonance characteristics.

A common approach for real ear measurements, until recent years, included steps to calculate a prescription based on hearing threshold levels, using known fitting rules to generate target insertion response curves. These target curves are a guide for the optimum adjustment of the hearing instrument amplification at the eardrum.

The current most popular approach to real ear measurements looks more closely at the actual sound pressure level (SPL) at the eardrum. The target for aided measurements is the *patient's own dynamic range of hearing*, determined by their hearing thresholds and UCLs.

WHAT IS THE REAL EAR AIDED RESPONSE (REAR)?

The Real Ear Aided Response (REAR) is the sound pressure level in the ear canal measured with the probe microphone close to the eardrum and the hearing instrument inserted in the ear and turned on.

Live Speech Mapping provides a unique opportunity for the patient to experience and understand the benefits of quality hearing instruments. "Seeing" the benefits of high end hearing instruments is important in the auditory rehabilitation process for the patient.

Live Speech Mapping (LSM) utilizes actual live speech (clinician’s and family members or significant others) as the input signal for measuring the Aided Response (AR) in Real Ear Measurements. Real speech is an interesting and familiar stimulus for the patient and family and, at the same time, this is the type of signal the hearing instrument is required to process.

Live Speech Mapping in Real Ear Measurements (REM) provides a dynamic presentation of how much "speech" is reaching the patient's eardrum. When measured in the unaided ear canal, LSM is used to counsel the patient and third party on the effect of the hearing

loss on understanding speech. (shows how much speech is not audible) A better understanding of the hearing loss usually makes it easier for the patient and third party to accept and commit to rehabilitative help. Live Speech Mapping is also a fast and accurate approach to successfully program hearing instruments for fitting and troubleshooting.

How it works: Speech input measured by the probe microphone is analyzed by the system and displayed in “real time” as a continuously updating peak curve from 125Hz to 8kHz. The measurement can be directly compared to the patient’s Audiogram values (in dB HL or dB SPL display), the modified aided speech spectrum, MCL and UCL values on the display. The live speech input level is monitored in real time with a **referenceVU** meter on the display. Louder or softer input levels are obtained either by varying distance between the speaker and the reference microphone or by adjusting the percentage output level of the external speaker accordingly.

During testing, a peak curve representing the maximum dB SPL reached at each discrete frequency over the duration of the live speech input appears on the screen. In addition, the actual dB level at each octave band is displayed as a bar at each octave and a text box displays the peak decibel level numerically at each octave or half octave frequency. This detailed information is useful in programming the gain and compression of the hearing instruments for soft, moderate and loud input levels.

Use LSM to verify fittings

When the hearing instrument is set to a comfortable volume, verify its performance for normal, soft and loud speech. If you have programmed the instrument correctly, the Live Speech Map will remain within the boundaries of the patient's dynamic range of hearing for soft, comfort and loud input levels. This demonstrates the advanced technology in the hearing instrument as it is self adjusting to provide the correct amount of amplification for the listening environment, without the need for the patient to continually adjust a volume control.

What is our target?

Consider the patient’s residual dynamic range as the target area for soft, comfortable and loud input levels. Soft speech should be audible for as many frequencies as possible. Remember, for some severe high frequency losses, audibility does not always contribute to improved speech understanding. Always evaluate aided speech understanding with appropriate post fitting materials. Comfort level speech should fall in the lower half of the dynamic range and Loud speech should never exceed the UCL values.

Optional :

You have the option of displaying a modified speech spectrum on the Live Speech map.

What is the modified speech spectrum? The long term speech spectrum for normal voice in quiet, modified to represent the most comfortable listening level for normal speech levels in quiet for the patient’s reduced dynamic range of hearing : loudness

normalization. When using the speech spectrum, aim to have the peaks of the measurement for comfort speech reach the top of the spectrum for as many frequencies as possible.

EXERCISES

LSM has multiple applications. The following exercises step you through the most common applications of LSM.

Please complete the previous lesson on using LSM within NOAH before attempting the exercises in this lesson.

EXERCISE ONE: DEMONSTRATE THE HEARING LOSS TO THE PATIENT AND THIRD PARTY USING LIVE SPEECH MAPPING IN THE UNAIDED EAR

EXERCISE TWO: VERIFY HEARING INSTRUMENT FITTINGS USING LIVE SPEECH MAPPING

Preparation for Exercise One.



- Open *NOAH* from the desktop.



- Open a client's folder. (select the client used in the NOAH lesson or start a new client and enter the audio values below:)



- Click the *real ear measurement module* icon on the toolbar. The Avant™ main menu appears on your screen.



- Click *LSM* on the main menu screen.

The first screen is **AUDIO**. The program automatically retrieves the patient's audiogram values in the patient's current record.

If you created a new patient for this lesson: enter the following audio values:



- *Right Ear, AC:*



20 at 250, 30 at 500, 40 at 1000, 50 at 2000 and 60 at 3000, 4000, 6000 and 8000Hz.

UCL

- Click *UCL* and enter the following values:

100 at 250, 100 at 500, 95 at 1000, 95 at 2000, 90 at 3000, 90 at 4000, 6000 and 8000Hz.



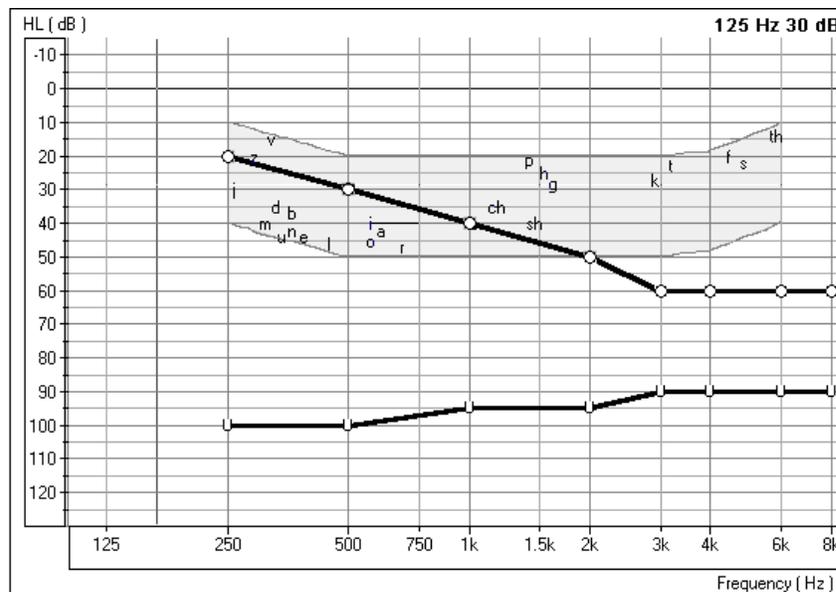
- Click *Help* to read a description of the AUDIO screen. Follow the links for speech spectrum and speech sounds overlay.

Close the help file using the *X* icon.

EXERCISE ONE: DEMONSTRATE THE HEARING LOSS TO THE PATIENT AND THIRD PARTY USING LIVE SPEECH MAPPING

- Explain the Audiogram to the patient and third party.

Include an explanation of the speech spectrum, the normal dynamic range of hearing and the patient's reduced dynamic range due to the hearing loss and the reduced tolerance levels (UCLs).



DEMONSTRATE UNAIDED LIVE SPEECH MAP



- Click the *HL Speech Mapping* icon on the taskbar.

The Hearing Loss (HL) Speech Mapping screen displays the Live Speech Map in dB HL. This allows the clinician to compare Live Speech input to the patient's audiogram values and long term speech spectrum on a familiar audiogram format. The peak values of the speech map must go below the patient's audiogram values before they are audible. The speech spectrum is a useful guide for demonstrating the frequency range of the different sounds in speech.

Review the audiogram graphic with the patient and third party again, this time adding the Live Speech Map function. Explain that unless sounds reach below the hearing threshold levels, they are not audible.



- Perform an otoscopic inspection of the patient's ear canal. Use the Video Otoscope preview mode by clicking on the *camera* icon on the toolbar.



Back

- Insert the probe tube into the patient's right ear canal. Use the VO to determine correct probe tube placement.

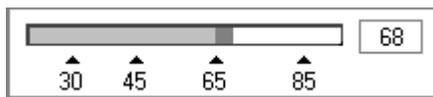
- Click *Back* to return to the HL Speech Mapping screen.

Position the patient facing you at a distance of 3 feet. Make sure the patient and third party can also see the monitor.

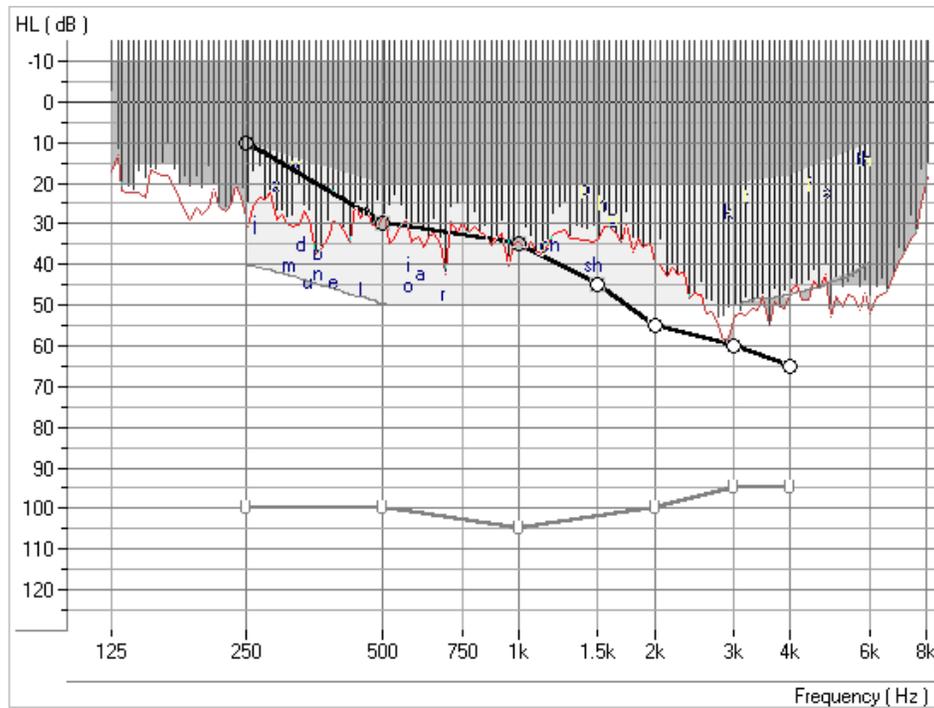


- Click *Start* or press Enter on the keyboard.

Speak in a normal conversational level. Monitor the input level with the VU meter on the display.



Monitor the dynamic Live Speech Map on the display and point out where your voice is audible and inaudible. In the following example, the low frequencies are audible (ie. Live speech map is louder than thresholds) however, the mid to high frequencies are not audible (ie. Live Speech Map does not reach threshold levels).



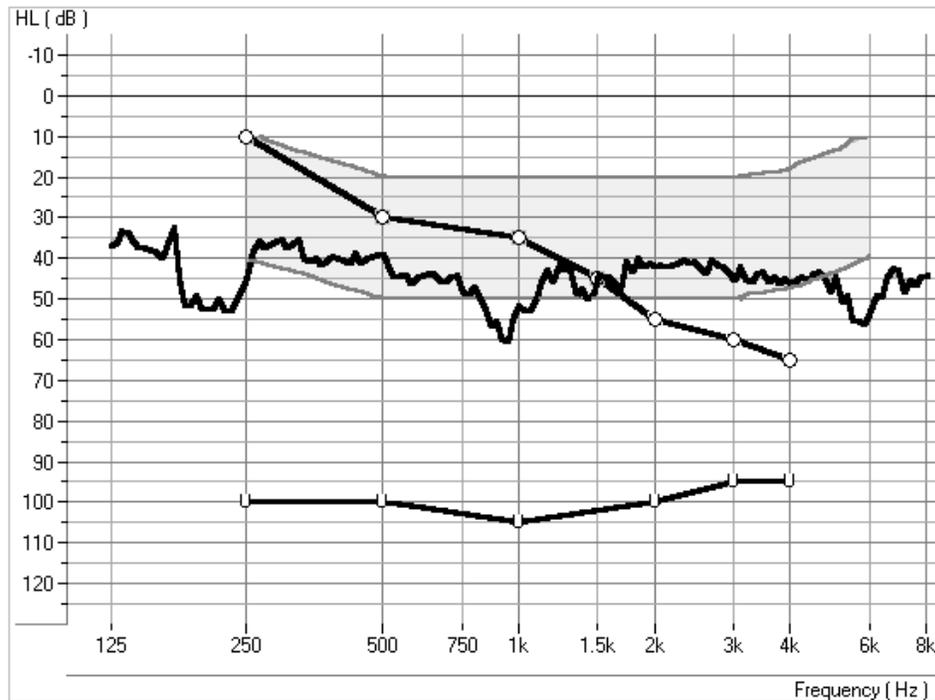
HL Speech Map

This is also a good time to demonstrate "pitch". Using a low and a high frequency tuning fork, you can further explain the distribution of pitch.

- Position the third party facing the patient at a distance of 3 feet and have the third party speak in a normal conversational level. Monitor the Live Speech Map and point out where important speech sounds are being missed.
- Click *Stop* or Esc on the keyboard.



The peak energy of the Live Speech Map recorded since you pressed Start is stored to the screen.



Stored LSM curve in HL Speech Mapping.



TO DISCARD UNWANTED STORED CURVES

Point and click the mouse to the stored Live Speech curve. The curve will momentarily change to a white line. Click *Discard*. The curve is removed from the display.

USING THE RAINBOW PASSAGE

It is useful to present material which is representative of long term speech for Live Speech Mapping. The Rainbow Passage provides all of American English speech sounds as they would occur in everyday speech.

A printable version of the Rainbow Passage is in online Help and in the back of this manual.

Position the patient facing you at a distance of 3 feet.

Make sure the testing room is quiet.

- Click *Start*.

Read the Rainbow Passage in your normal speaking voice. As soon as you have completed the Rainbow Passage, immediately click the *Stop* icon.

Look at the stored Live Speech Map curve on the display and provide feedback to the patient.

You can repeat this exercise with the third party speaking the Rainbow Passage.

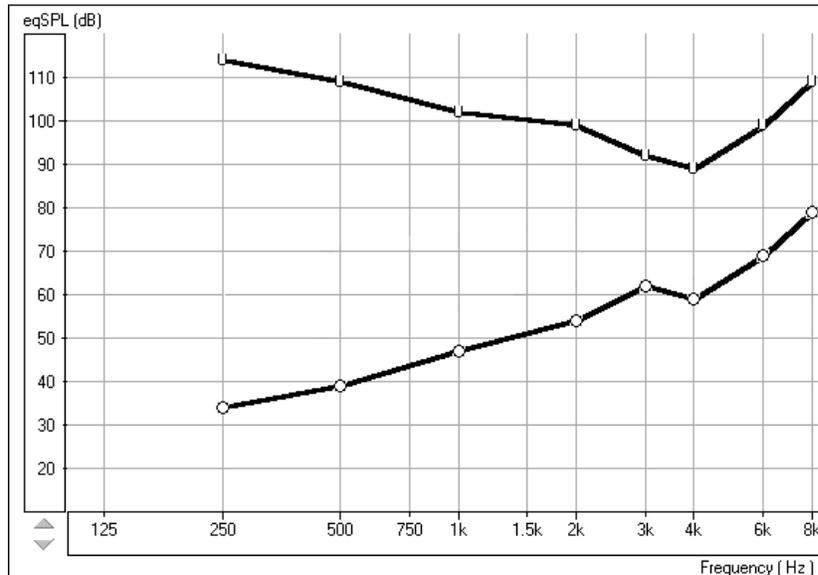


UNAIDED LIVE SPEECH MAPPING IN DBSPL



- Click *Live Speech Mapping* on the taskbar.
- Click *Help* and become familiar with the display and icons used in Live Speech Mapping. Read the link to Live Speech Mapping.

Close the help file using the *X* icon.



LSM display

Explain the display to the patient and third party. The display still shows the patient's hearing loss and tolerance levels, however this time the graph represents soft sounds at the bottom and very loud sounds at the top. Until sounds reach the hearing threshold levels, the patient cannot hear the sounds. When the sounds go higher than the U symbols, they become intolerable.



- Perform an otoscopic inspection of the patient's ear canal. Use the Video Otoscope preview mode by clicking on the *camera* icon on the toolbar.
- Insert the probe tube into the patient's right ear canal. Use the VO to determine correct probe tube placement.



Back

- Click *Back* to return to the REAR screen.



- Click, *Right Ear*.

Position the patient facing you at a distance of 3 feet. Make sure the patient and third party can also see the monitor.



- Click *Start* or press Enter on the keyboard.

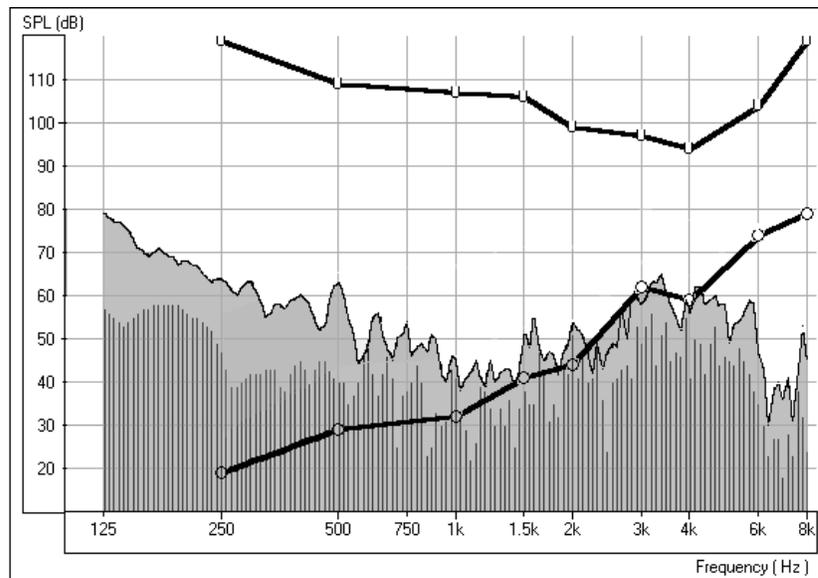
Speak in a normal conversational level. Monitor the input level with the VU meter on the display.



Monitor the dynamic Live Speech Map on the display and point out where your voice falls below threshold.

This is also a good time to demonstrate "pitch". Using a low and a high frequency tuning fork, you can further explain the distribution of pitch.

Position the third party facing the patient at a distance of 3 feet and have the third party speak in a normal conversational level. Monitor the Live Speech Map and point out where important speech sounds are being missed.



Live Speech Map for unaided normal speech



- Click *Stop* or Esc on the keyboard.

The peak energy of the Live Speech Map recorded since you pressed Start is stored to the screen.



Discard

- Point and click the mouse to the stored Live Speech curve. The curve will momentarily change to a white line. Click *Discard*. The curve is removed from the display.

USING THE RAINBOW PASSAGE

It is useful to present material which is representative of long term speech for Live Speech Mapping. The Rainbow Passage provides all of American English speech sounds as they would occur in everyday speech.

A printable version of the Rainbow Passage in the help files and at the end of this training guide.

Position the patient facing you at a distance of 3 feet.

Make sure the testing room is quiet.

Click *Start*.



Read the Rainbow Passage in your normal speaking voice. As soon as you have completed the Rainbow Passage, immediately click the *Stop* icon.



Look at the stored Live Speech Map curve on the display and provide feedback to the patient. You are aiming to have the curve between the lower one third and one half of the dynamic range.

You can repeat this exercise with the third party speaking the Rainbow Passage.

These curves provide a good comparison to any aided Live Speech curve measured in the same manner.

EXERCISE TWO: VERIFY HEARING INSTRUMENT FITTINGS USING LIVE SPEECH MAPPING

The main objective of hearing instrument fittings is to make as much speech information available to the patient as possible. The verification procedure used when fitting hearing instruments MUST include real ear measurements using Live Speech.

NB: If you are proceeding from exercise one, remain in the Live Speech Mapping task. Otherwise follow the next step.

- Click *LSM* on the main menu screen.

The first screen is AUDIO.

- Enter the audio as for exercise one.

Review the Audiogram with the patient and third party. Include an explanation of the speech spectrum, the normal dynamic range of hearing and the patient's reduced dynamic range due to the hearing loss and the reduced tolerance levels (UCLs).

- Click *Live Speech Mapping* on the taskbar.

Explain the display with the patient and third party. You will have performed an unaided demonstration at the hearing test appointment, so this is not the first time they have seen this screen.



If you did not perform an unaided demonstration of Live Speech Mapping at the first appointment, spend some time explaining this screen. The display still shows the patient's hearing loss and tolerance levels. The graph represents soft sounds at the bottom and very loud sounds at the top. Until sounds reach the hearing threshold levels, the patient cannot hear the sounds. When the sounds go higher than the U symbols, they become intolerable.

- Make sure you have pre-programmed the new hearing instrument prior to this appointment. (see Lesson Two)

Place the patient's new hearing instrument in the test ear. Take care not to advance the probe microphone tube further into the ear when you insert the hearing aid.

Position the patient facing you at a distance of 3 feet.



- Click *Start* or press Enter on the keyboard.

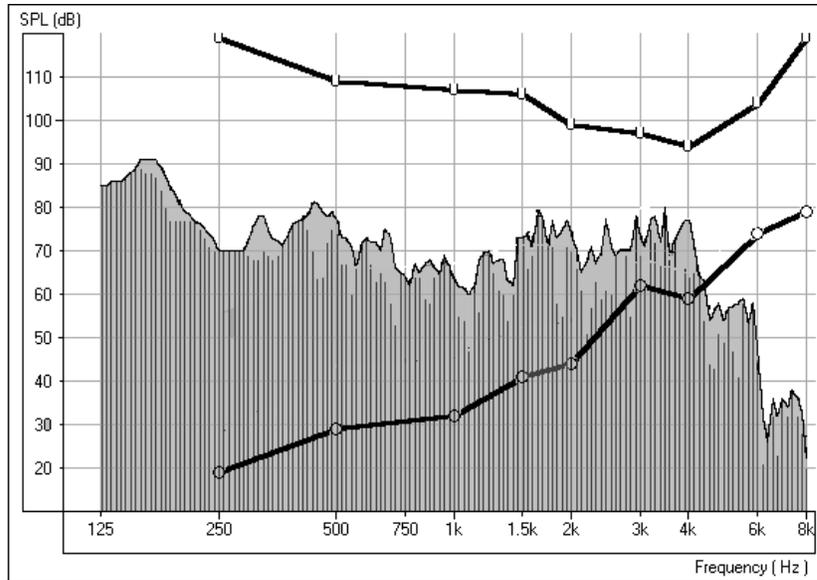
Begin speaking to the patient at a normal conversational level (65-70dB). You can present the Rainbow passage, or read from any other magazine article.

Adjust the programming as necessary for the peaks of comfort level speech to be at the top of the aided speech spectrum.

Note: The hearing instrument can be programmed from the fitting module in NOAH or from manufacturer specific stand alone programs installed on your Avant™. The exercises in Lesson Two teach you how to program within NOAH. To use a stand alone fitting program, minimize the Avant™ program and open the manufacturer's fitting software from the desktop. Program the aid and return to the LSM screen using **Alt + Tab** keys on the keyboard. Press and hold the Alt key down and press once on the Tab key to toggle between the opened programs.

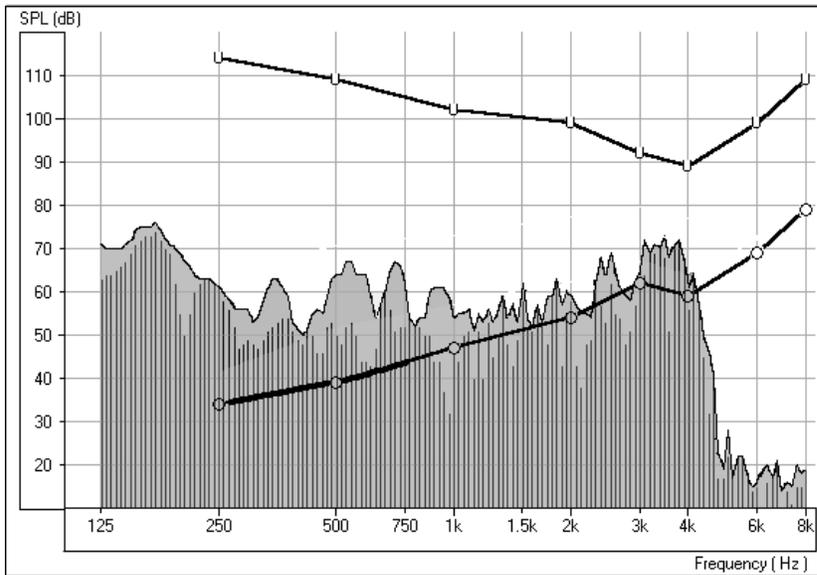
Many hearing instruments have at least two independent channels in which to adjust gain and an adjustable cross over frequency to set the width of these channels.

Make adjustments to these parameters until comfort level speech measurements are between the lower third and half of the dynamic range.

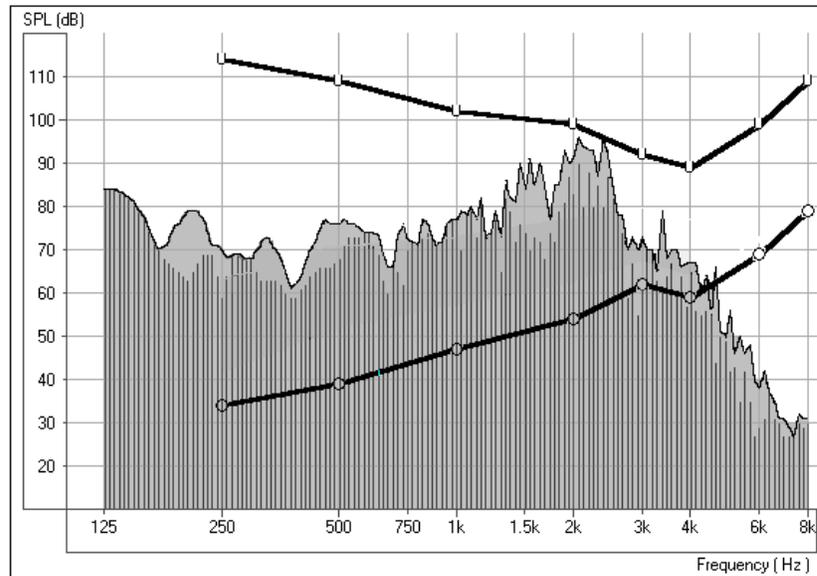


Normal conversational speech Live Speech Map

Continue with the Live Speech Mapping by demonstrating the instrument's performance for **soft** and **loud** speech. Aim to have as much of the soft speech audible for as many frequencies as possible. You may need to adjust the kneepoint(s) to allow sufficient gain for soft inputs. Make sure the UCL tolerance limits are never exceeded for a loud input. Make adjustments to the compression ratios or limiting to ensure the UCL's are never exceeded for loud inputs.



Good soft speech Live Speech Map



Good Loud speech Live Speech Map

If you have programmed the instrument correctly, the Live Speech Map will remain within the boundaries of the patient's dynamic range of hearing for soft, comfort and loud input levels.

EXERCISE THREE: FEEDBACK USING LSM

Live Speech Mapping can be used to monitor for feedback. It is possible to "see" feedback before it is audible to you.

Live Speech Mapping is also used to demonstrate directional microphone effects, compression features, volume control adjustments, ear mold modifications and multiple memories.

FEEDBACK

One of the biggest challenges faced in hearing instrument fittings is "feedback". Live Speech Mapping is a unique and effective approach to dealing with feedback.

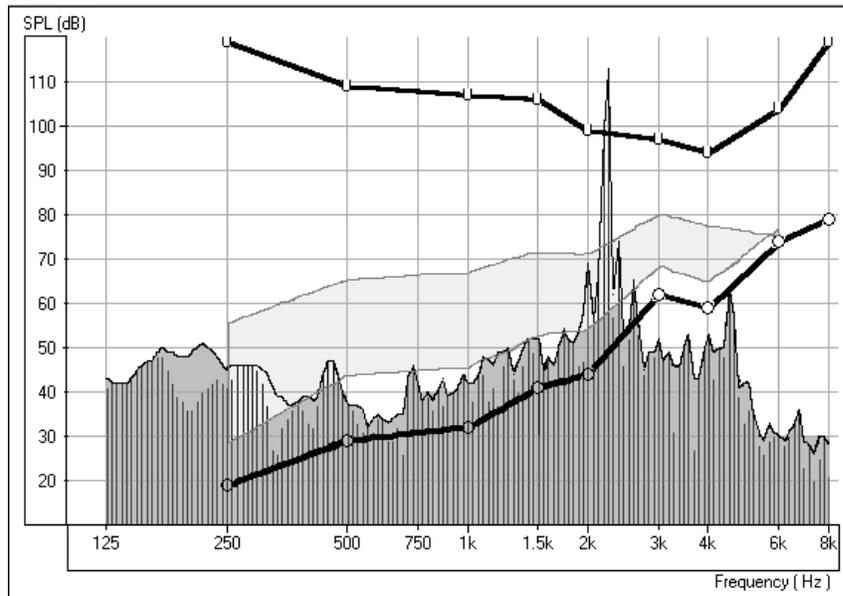
When a hearing instrument is in "feedback", it adds distortion and is a source of annoyance to the wearer and others who can hear it. When you are performing Live Speech Mapping, you can monitor the curve on the screen for the presence of feedback. It is possible to "see" feedback before it is audible to you.

What does feedback "look" like?

Look for a "spike" in the Live Speech curve in the high frequencies.

You may see one big spike in the response, in addition to other smaller spikes at higher frequencies than the big spike. The big spike represents the fundamental frequency of the feedback and the smaller spikes are harmonics of this fundamental.

The following diagram illustrates feedback with a fundamental peak frequency at 2200Hz.



Feedback at 2200Hz

How to eliminate feedback?

Firstly, check that the hearing instrument is properly inserted in the patient's ear.

Make sure the overall volume of the hearing instrument is set to the patient's preferred listening level for normal conversation.

Adjust the gain for the fundamental frequency of the feedback. This is where the spike is biggest.

Make sure these adjustments to the hearing instrument have been effective in eliminating the feedback by repeating the Live Speech Mapping curve.

When feedback is removed, repeat the Live Speech verification procedure to be sure you still have adequate gain for comfort and soft speech.

LESSON SIX

Occlusion Effect

One of the biggest concerns we have in hearing instrument fittings is dealing with the common complaints of: " I sound like I am in a barrel"; "I don't like the sound of my own voice"; "My own voice seems too loud"; " I feel blocked up".

Our knee-jerk reaction upon hearing these complaints is to quickly grab the offending hearing instrument, run to the back room and start modifying the aid by grinding on it, or by decreasing low frequency gain. Sometimes this works. Why doesn't it work all the time?

In order to treat these complaints effectively, it is necessary to have a good understanding of the cause of the complaint. Is the cause due to the Occlusion Effect? Or is the complaint due to an incorrect frequency response in the aid?

What is Occlusion Effect?

The definition of Occlusion Effect is the build up of self-generated energy (patient's own voice) in the ear canal, due to the coupling of the hearing aid to the patient's ear.

Basically, by plugging up the ear canal with a hearing instrument, we trap some of the low frequency energy created when the patient speaks. This low frequency energy is transmitted through the skull to the external ear. When the ear canal is not blocked, this energy escapes down the ear canal and is not heard.

EXERCISES

EXERCISE ONE: OCCLUSION EFFECT DEMONSTRATION

EXERCISE TWO: MEASURING THE OCCLUSION EFFECT

What is Occlusion Effect?

The Occlusion Effect is a specialized, yet easy to perform test, to *objectively* assess clients who report discomfort with their own voice. Some clients report they seem like they are "speaking in a barrel" or "feel blocked up". These are signs of a build up of low frequency energy in the ear canal. However, occlusion effect may not be the cause in all cases.

The amount of trapped low frequency energy in the ear canal can be measured objectively in the Occlusion Effect function in the Live Speech Mapping (LSM) menu.

To measure the Occlusion Effect, we use the patient's own voice as the stimulus and the real ear probe microphone positioned at the eardrum. The patient vocalizes "eeeeee" without the hearing aid in the ear, performing the Open Ear Spectrum measure. This measure is then compared to the same vocalized input with the hearing aid in the ear, but turned off. The resulting difference is the Occlusion Effect.

EXERCISE ONE: OCCLUSION EFFECT DEMONSTRATION

With both hands cupping each side of your chin, along your jawbone, rest your elbows on a hard surface.

Say the sound "Shhhhhh".

Now say the sound "Eeeeeeeeee".

Which of these two sounds do you "feel" as vibration on your hands?

The "eeeeee" sound will generate more vibration.

This time, place the tip of your index finger in each ear canal to close the canal. Make the same sounds "Shhhh" and "Eeeee".

Which is louder?

The "eeeeee" sound will be louder.

You have just experienced the Occlusion Effect.

EXERCISE TWO: MEASURING THE OCCLUSION EFFECT



Back



- Click *LSM* on the main menu screen for the Avant™.

- Click *O/E* on the taskbar.

About the display: The grid on the left of the display has a dB SPL vertical axis and a Frequency in Hertz horizontal axis. The only icons on the control panel are for test ear.

- Click *Right Ear*.

The first step is to perform an Open Ear Spectrum measurement, which will act as a baseline for this patient's normal voice level in the ear canal.

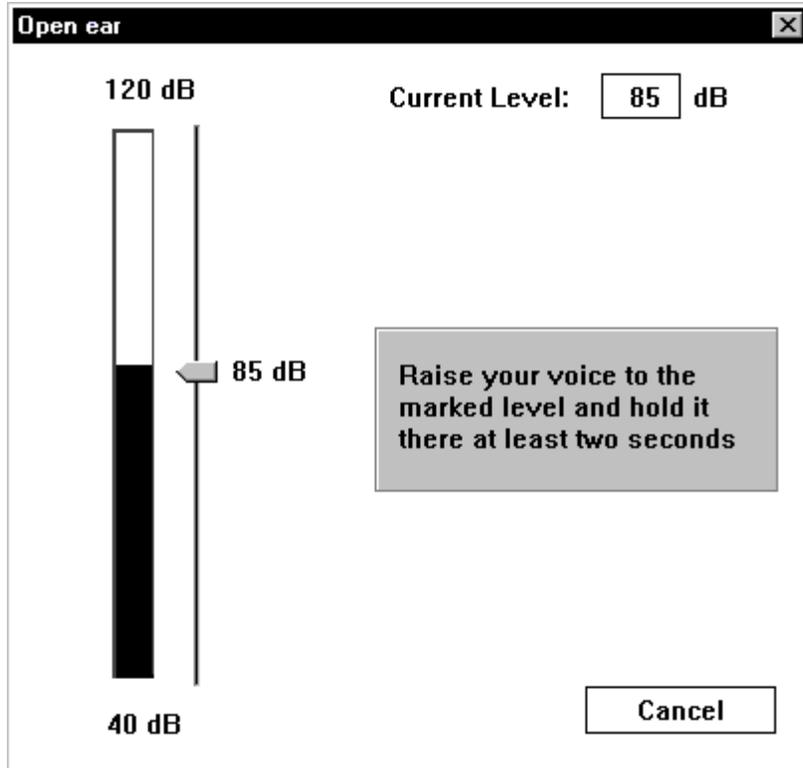
- Click the *camera* icon and perform an otoscopic exam of the ear canal.
- Click *Back* to return to the Occlusion Effect screen.

Insert the probe microphone to within 6mm of the eardrum.

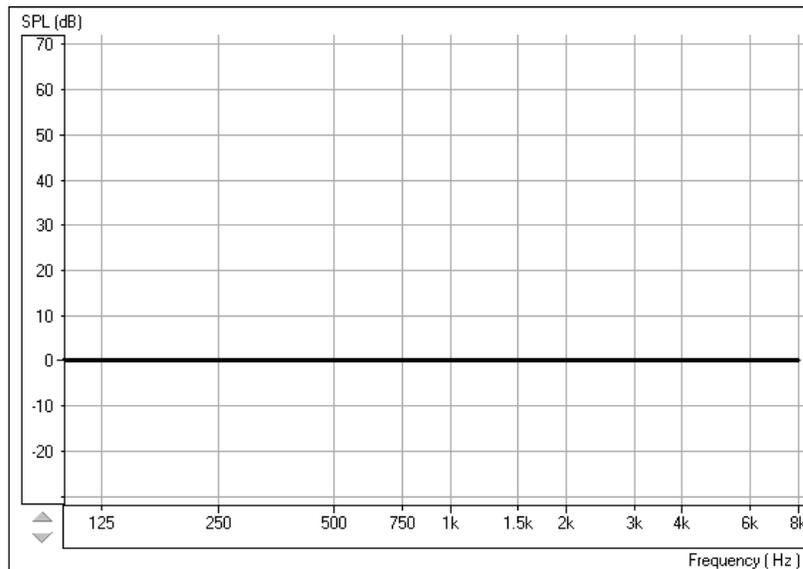
- Click *START*.

A vertical VU meter appears on the screen.

Instruct the client to make the sound "eeeeee" and hold this sound constant at the target level indicated by the arrow. The default level is 85dB. When the appropriate level is reached and sustained for two seconds, the system stores the measure to the screen automatically.



When the Open Ear measurement is stored, you will see a colored line at zero dB on the display to indicate the program has “normalized” the client’s Open Ear Spectrum for comparison to the next "occluded" measurement.



Tip: If the patient has difficulty holding their voice level to 85dB, click the *Arrow* icon on the Volume Level meter and drag up or down to the desired level. This is only required for patients with very soft or loud voices.

OCCLUDED EAR MEASUREMENT.

Insert the patient's hearing aid, making sure you do not advance the probe tube further down the ear canal. The hearing instrument is turned OFF and the battery door is closed.



- Click *Start*.

A text box message appears and requests you to confirm you are performing the Occluded Ear measurement or allowing you to repeat the Open Ear Spectrum measure. Only repeat the open ear measure if you are dissatisfied with the first Open Ear Spectrum measurement.

The program defaults to selecting the Occlusion Effect option.



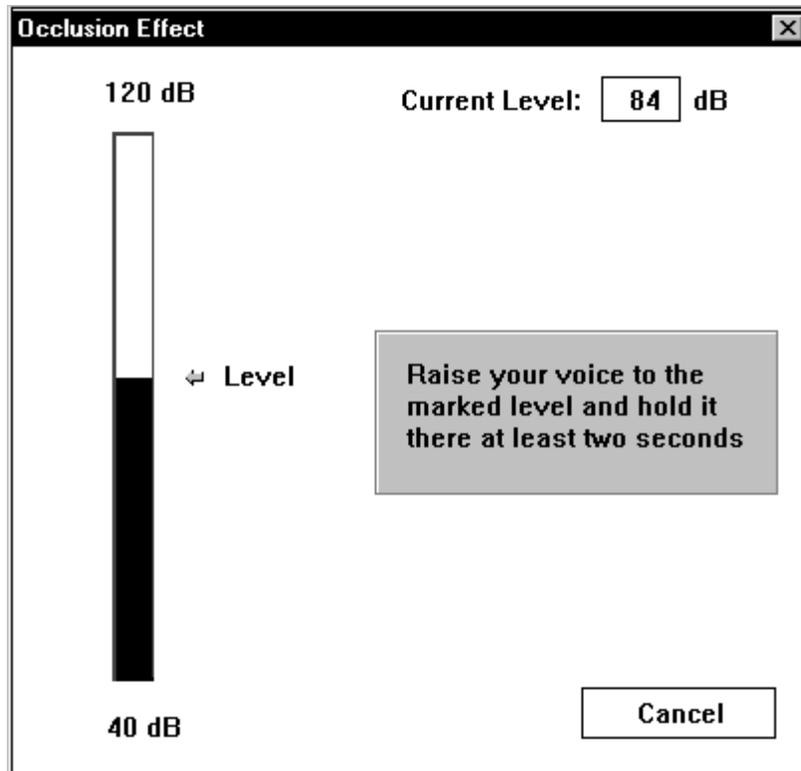
- Click *OK*.



The Volume Level meter appears on the screen to show the "target" voice level for the patient to reach when saying "eeeeee".

Instruct the patient to say "eeeeeee" while you point to this "target" level until the measurement is captured.

The Occlusion Effect curve is plotted to the screen automatically after the patient has sustained an "eeeeeeeee" at the target level for one second.

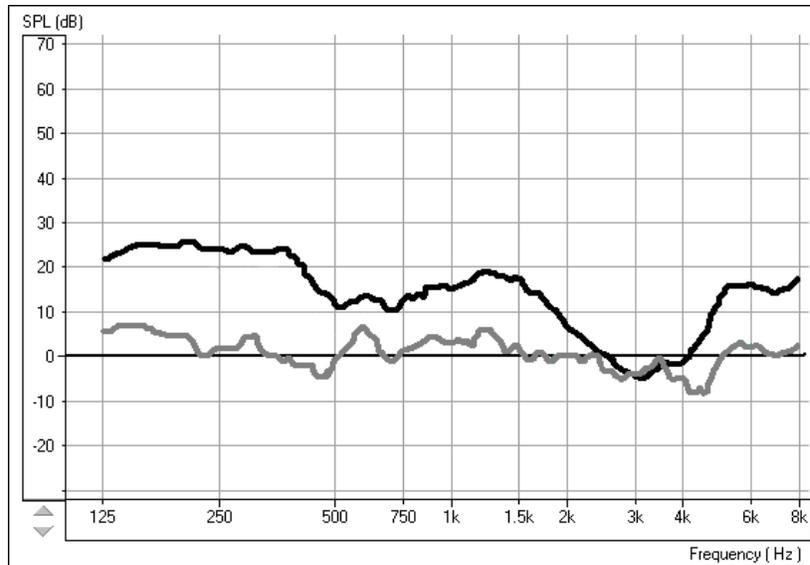


Target Level for Occluded measurement

Note: You can customize the “smoothness” of the occluded ear response curve by going to **Options / Live Speech / Smooth O/E**. The default smoothing is 7 points.

Interpreting the results

Usually, a measure of 20 dB SPL or more in the low frequencies is noticeable occlusion effect to the client and indicates a need to modify the hearing instrument fitting to reduce this effect. Subsequent measures of the Occlusion Effect can reveal if such modifications have been effective in reducing the amount of occlusion.



The top curve indicates significant occlusion effect. The lower curve is a close match to the normalized zero line and does not indicate significant occlusion effect.

Suggested modifications to the hearing instrument include:

- Increasing the insertion depth
- Tapering the canal tip of a CIC
- Maximizing the venting, while considering the risk of feedback.

A key to good customer service is to **always** be prepared to take a new, deep impression.

If you are unable to reduce the amount of occlusion effect by making physical changes to the hearing instrument, consider increasing the low frequency gain of the instrument. This additional low frequency gain may "mask" the amount of trapped energy in the ear canal, making it less noticeable to the patient when they speak.

What can you do if you do not measure any significant occlusion effect?

No amount of modifications to the shell or acoustic coupling of the hearing instrument to the patient's ear canal will change the patient's complaints about their own voice if you do not measure any occlusion effect.

The cause of the patient's complaints is more likely to be an inappropriate frequency response or other acoustic amplification characteristic of the hearing instrument.

Return to the *LSM* and make adjustments to the frequency response while monitoring the patient's subjective response in regard to the pleasantness of their own voice. Monitor the patient's own voice using Live Speech Mapping.

LESSON SEVEN

REAL EAR MEASUREMENTS (REM)

Do not be overwhelmed by the number of tasks offered under the REM menu. We strongly advocate the use of Live Speech Mapping for verifying hearing instrument fittings.

The ANSI standard for real ear measurement tasks describes the tests included in our menu. For a definition of each standard measurement, please refer to the online Help menu.

INTRODUCTION TO REAL EAR MEASUREMENTS

Real Ear Measurements have become a widely accepted and essential tool for verifying the outcome of hearing instrument fittings. Real ear measurements are measurements of sound obtained with a probe tube microphone placed at the eardrum of the patient, therefore taking into account the specific external ear resonance characteristics of the patient. The procedure includes steps to calculate a prescription based on hearing threshold levels, using known as fitting rules to generate target insertion response curves. These target curves are a guide for the optimum adjustment of the hearing instrument amplification at the eardrum.

The current most popular approach to real ear measurements requires looking at output SPL in the real ear aided response function, using the patient's residual dynamic range as the target fitting area.

Assumption

It is assumed you have a basic audiological knowledge sufficient to carry out hearing instrument fittings and are familiar with the concepts of hearing instrument fitting supported by real ear insertion gain measurements.

In addition to diligently carrying out Real Ear Measurements to provide a means of adjusting, comparing and verifying hearing instrument settings at the patient's eardrum, you are encouraged to obtain other qualitative judgments and speech discrimination scores, judge the patient's reactions, and use your clinical experience when fitting hearing instruments.

REAL EAR MEASUREMENT MENU

Audio
Fitting Rx
Real Ear Unaided Response (REUR)
Real Ear Unaided Gain (REUG)
Real Ear Insertion Gain (REIG)
Real Ear Aided Response (REAR)
Real Ear Aided Gain (REAG)
Real Ear Occluded Response (REOR)
Real Ear Occluded Gain (REOG)
Real Ear to Coupler Difference (RECD)

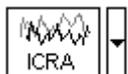
Each Real Ear task is defined and described in online Help. To perform any of these tasks, please follow the directions provided in the Help menu, accessed from the Help icon on any screen.

In addition to Live Speech Mapping to verify hearing instrument fittings, some clinicians like to use the ICRA stimuli in REAR. The following exercise provides some guidelines for using ICRA sounds in aided testing for real ear measurements.

EXERCISE ONE: USING ICRA-NOISE TO VERIFY NON-LINEAR HEARING INSTRUMENT FITTINGS

ICRA-Noise is a new stimulus designed for testing non-linear hearing instruments.

One method for using the ICRA-Noise stimulus options is outlined below.



- Click *ICRA* on the control panel.
- Click the *down arrow* icon beside the ICRA icon.
- From the drop down track options, select Track 4, 1 Female 3-band single speaker. This is a measure of response of the aid for a female voice at comfort level.
- Set the level to the patient's MCL.

With the probe microphone still in the ear canal, insert the patient's hearing aid in their ear. Take care not to advance the probe microphone tube further into the ear when you insert the hearing aid.

[NOTE: the probe tube microphone must be recalibrated every time the tube is replaced or changed in length. Probe Tube Calibration can be accessed from the *Calibration* menu on the main screen or from *Tools/Calibrate Probe Tube* menu in Real Ear]

Position the patient facing the box loudspeaker at a distance of no more than 3 feet.



- Click *Start* or press Enter on the keyboard.

The stimulus level will be adjusted automatically before the ICRA noise is initiated. The sampling time recommended is 20 - 30 seconds. The sampling time is either pre-determined in the program or can be set under **Options | Options | Average Time (sec)**.

The REAR curve stored to the screen is an FFT analysis of the output measured at the probe microphone for the duration of the stimulus.

Aim to have the peaks of the curve in the middle of the dynamic range.

- Repeat this procedure using Track 5, 1 Male 3-band single speaker.

Again, aim to have the REAR measurement peaks midway between threshold and UCL.

Test at Loud Level



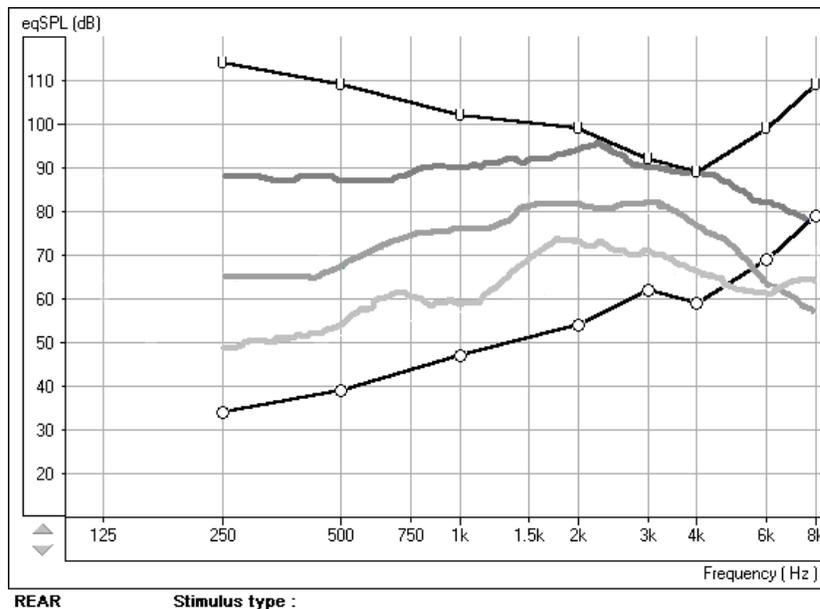
- Click the *down arrow* icon next to the ICRA icon.
- Select Track 9, 1 female + 1 male and 2 female + 2 male, loud voice spectra.

Do not adjust the attenuator Test level. Keep the test level at the patient's MCL.



- Click *Start* or press Enter.

The REAR curve stored to the screen should not exceed the patient's UCL at any frequency.



LESSON EIGHT

Tympanometry and reflexes

Tympanometry

Tympanometry reflects change in the physical properties of the middle ear system and tympanic membrane (TM) as air pressure in the external ear canal is varied. Tympanometry requires an airtight seal between the probe and external ear canal walls. Air pressure, measured in deca Pascals (daPa), is varied positive and negative relative to atmospheric pressure and the dynamic effects of air pressure changes on the acoustic impedance properties of the middle ear are measured.

The graphic representation of acoustic impedance as a function of ear canal pressure is called a **tympanogram**.

Tympanometry is used to identify and classify middle ear disorders. Tympanometry and reflex testing can also be included in a test battery to reveal information on specific disorders of the auditory brainstem and peripheral auditory nervous system.

Getting Started

Please read the User Guides supplied with the tympanometer hardware.

Connect the receiver provided with the tympanometer according to the tympanometer manuals. You may need to set up the tympanometer itself (e.g. serial port baud rate) to communicate with the receiver.

To make the Avant™ use the tympanometer, start the Avant™ program and choose **File | Advanced Options | Tympanometry** from the main menu screen.

From the drop-down box choose the type of tympanometer. Click on **Setup** and make sure the communication options match the tympanometer hardware settings.

HOW TO PERFORM TYMPANOMETRY

Read the tympanometer hardware manuals to learn how to operate the tympanometer.

- Click the *Tympanometry* icon from the main menu.

After an otoscopic examination of the ear and determination of an unobstructed ear canal and absence of discharge, select an appropriate sized, clean probe tip and attach it to the tympanometer.

Instruct the patient to keep still while the probe is in the ear canal.

Insert the probe to achieve an airtight seal.

Perform the test according to hardware manual instructions.



When the test is complete, transmit the data to the Avant TM (read the tympanometer manuals on how to transmit data). Some tympanometers may require you to push the *Transmit* button on the screen (if such button is available) to activate the data transfer, while others do the transfer automatically.

INTERPRETING TYMPANOMETRY RESULTS

The graphic representation of acoustic impedance as a function of ear canal pressure is called a *tympanogram*. The tympanogram is displayed as volume in cubic centimeters (cc) of movement as a function of pressure (daPa). Note: One cubic centimeter is equivalent to one milliliter.

The data table charts the *ear canal volume*, *middle ear pressure* and *static compliance*.

Ear Canal Volume: cc

Middle Ear Pressure: daPa

Static Compliance: cc

Ear canal volume: is the volume of the external ear canal measured at +200daPa when the tympanic membrane is most taut.

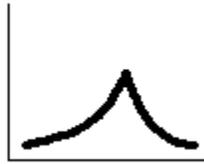
Middle ear pressure: is the pressure of the middle ear at which peak compliance is determined.

Static compliance: is the resting compliance of the middle ear and is calculated at the peak compliance minus the external ear canal volume.

INTERPRETING THE TYMPANOGRAM

Type A

The shape of this tympanogram shows that there is less middle ear movement when the middle ear system is stiffened when air pressure is varied from atmospheric pressure. The middle ear system moves best at atmospheric pressure (0daPa). A Type A tympanogram shows normal middle ear function. The normal compliance (movement) limits for a type A tympanogram are: 0.3 -1.6cc.



Type As

A Type As is a shallow Type A tympanogram with a peak compliance less than 0.3cc. This pattern is consistent with otosclerosis and some cases of middle ear effusion.



Type Ad

A Type Ad is a deep Type A tympanogram with a peak compliance greater than 1.6cc. This pattern is consistent with a flaccid, intact tympanic membrane or ossicular discontinuity.



Type B

A Type B has a "flat" tympanogram configuration., indicating little change in middle ear movement with changes in ear canal pressure. There are two types of Type B tympanogram, each determined by the ear canal volume.

Low volume Type B

The low volume type B tympanogram is consistent with middle ear effusion.



High volume Type B

The high volume Type B tympanogram is consistent with a perforated tympanic membrane or patulous ventilation tube.

Type C

A Type C tympanogram shows peak movement at significant negative pressure ($< -100\text{daPA}$). This is most often consistent with Eustachian tube dysfunction.



Reflexes

Stapedial reflex measures form a valuable component of impedance testing. The stapedius muscle, attached to the stapes in the middle ear, contracts in response to a loud acoustic signal. This response is termed the acoustic stapedial reflex and is often abbreviated to AR. The AR occurs bilaterally which means it can be elicited by an acoustic signal presented to either ear.

The Avant™ is designed to measure ipsilateral acoustic reflexes, meaning the reflex is measured in the same ear as the acoustic signal is produced.

The probe measures changes in the middle ear impedance when a loud sound is presented. The stapedius muscle contracts with the loud sound and causes an increase in acoustic impedance at the tympanic membrane during the contraction. Resulting acoustic reflexes are dependent on an intact, normal middle ear system and an intact afferent (sensory) and efferent (motor) neural system associated with the stapedius arc.

Abnormalities in any of these systems results in abnormal AR measures.

The Avant™ screens for the presence or absence of an AR at 500, 1000, 2000 and 4000Hz at 95dBHL.

HOW TO PERFORM ACOUSTIC REFLEX TESTING

Note: Some tympanometers may perform the Tympanometry and the reflex tests at one pass. Please consult the hardware manuals.

Please read the tympanometer User Guide for instructions on how to operate the hardware for Acoustic Reflex measurements.

Select an appropriate sized, clean probe tip and attach it to the tympanometer.

- Select *Reflexes* on the taskbar.

Tell the patient to expect a series of loud, but not uncomfortable, tones in the test ear. No response is required from the patient to these tones.

Instruct the patient to keep completely still during testing.

Insert the probe and maintain an airtight seal.

Press and hold down the small AR test button on the HandTymp, keeping your hand steady while testing.

Perform the test according to hardware manuals.

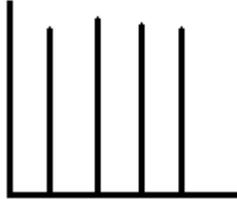
When the test is complete, transmit the data to the Avant™ (read the tympanometer manuals on how to transmit data). Some tympanometers may require you to push the *Transmit* button on the screen (if such button is available) to activate the data transfer, while others do the transfer automatically.

INTERPRETING AR RESULTS

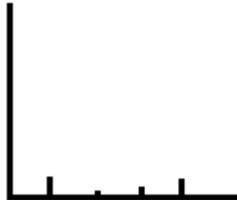
The Avant™ displays the AR data as the size of the reflex (in cc) for each frequency tested.

Since the Avant™ is designed to make a screening test for AR, the results should be interpreted for the presence or absence of an acoustic reflex.

There are two outcomes possible:



Acoustic reflexes of equal and moderate strength measured for all frequencies are consistent with normal middle ear function.



The absence or presence of very small reflexes. This outcome is consistent with either middle ear disorders, high reflex thresholds or lack of integrity of the neural arc for acoustic reflexes.

Note: An unsteady hand during reflex testing can yield anomalies in test data, such as a reflex at only one frequency. Repeat the test to achieve accurate data and transmit the data to the Avant™. The new data will overwrite the old data.

LESSON NINE

HEARING LOSS SIMULATOR(HLS) AND MASTER HEARING AID(MHA)

Hearing Loss Simulator (HLS)

The Hearing Loss Simulator “simulates” the effect of the client’s hearing loss for the spouse or family member. The program attenuates an input signal to simulate the audiogram. It is a powerful counseling tool for the spouse or family member, who can listen to how their own voice is distorted by the hearing loss.

EXERCISES

EXERCISE ONE: USE THE HLS TO SIMULATE THE DIFFERENCE BETWEEN NORMAL HEARING (NORMAL) AND THE PATIENT’S HEARING LOSS (SIMULATED)

EXERCISE TWO: SIMULATE THE POTENTIAL IMPROVEMENT IN THE PATIENT'S HEARING PERFORMANCE WHEN HEARING INSTRUMENTS ARE WORN

EXERCISE THREE: USE THE HEARING LOSS SIMULATOR TO SIMULATE THE NATURAL DETERIORATION IN THRESHOLDS OVER TIME

Operating the Avant™ from NOAH



- Open *NOAH* from the desktop.
- Open the Client folder and select the client to be seen.
- Click the real ear measurement module icon on the toolbar.



The Avant™ main menu appears on your screen.

- Click the MHA / HLS icon on the main menu.



EXERCISE ONE: SIMULATE THE DIFFERENCE BETWEEN NORMAL HEARING (NORMAL) AND THE PATIENT’S HEARING LOSS (SIMULATED)

Setup for Hearing Loss Simulator

There are three tabs on the MHA/HLS taskbar. The first is AUDIO. This screen shows the patient's audiogram for the current record. It displays the data for the test ear selected on the control panel. If the current record has audiometric data, it will automatically import to this display.

Manual entry of audio data: If there is no audiometric data in the current record, you can manually enter the audiogram in the AUDIO screen. Click *Right Ear* and *AC* on the control panel and simply point the mouse to the value on the audiogram, example 30dB at 1000Hz, and click the mouse button. The appropriate AC symbol for right ear air conduction threshold is plotted to the audiogram. Click *Left Ear* and enter air conduction values for the left ear.



For the purposes of this exercise, enter the following audiogram values for the *Right Ear*:

20 at 250, 30 at 500, 40 at 1000, 50 at 2000, and 60 at 3000, 4000, 6000 and 8000Hz.

!!!!!!Note: Any time you make changes to audiogram data in a screen with the title AUDIO, you are making permanent changes to the record. The only screen where you can make changes to the audiogram data and NOT effect the data stored in the opened record is in the Hearing Loss Simulator (HLS) screen.



- Click the *HLS* tab on the taskbar.



- Click *Help* and read about Hearing Loss Simulation. Follow the link to the Hearing Loss Simulator icons and become familiar with the icons used in this demonstration.



- Click *Right Ear*, *Normal*, and *File*. File input option accesses the audio track stored on the system hard drive. The MedRx Sounds Sensations CD in on File.



Make sure the speakers used by your system for the Hearing Loss Simulator are connected to the system and turned on.



- Select *Track 2* on the CD control panel.

Explain the audiogram to the third party. Pay special attention to the speech area.

Explain the “simulation” activity. First, the third party will listen to music in the Normal mode. When you click Simulated, the third party will hear the music adjusted for the patient's hearing loss.

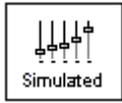
Position the third party so that they are near the speakers and can view the monitor easily.



- Click *Play* on the CD control panel.

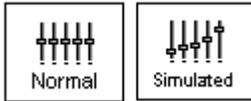


- Adjust the volume control if the third party has difficulty hearing the music. Click -5 or +5 icons to increase or decrease the volume respectively. In most cases, you will not need to adjust the volume.

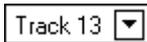


Allow the third party to listen to the music for 20 - 30seconds, reinforcing that this is how the third party normally hears this music.

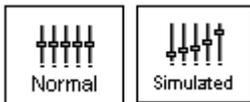
- Click *Simulated*. Tell the third party that they are now listening to the patient's hearing loss.



- Alternate between *Normal* and *Simulated* so that the third party can appreciate the difference.



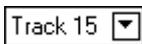
- Repeat the simulation with Track 13, which is a female voice in quiet.



Alternate between *Normal* and *Simulated*.

This provides a good demonstration of why the patient says the third party "mumbles". The hearing loss makes it sound like the female voice is mumbled.

The next track demonstrates how the patient's hearing loss can affect their safety.



- Select *Track 15* and click *Simulated*. Press *Play* on the CD control panel and ask the third party to identify the sound. It will take some time until the third party recognized the approaching train whistle.



When they have identified the sound, press *stop* and replay track 15 in the normal mode. Click *Normal* and then *Play*.



This is an effective demonstration of how the patient may not be hearing important environmental sounds for safety.

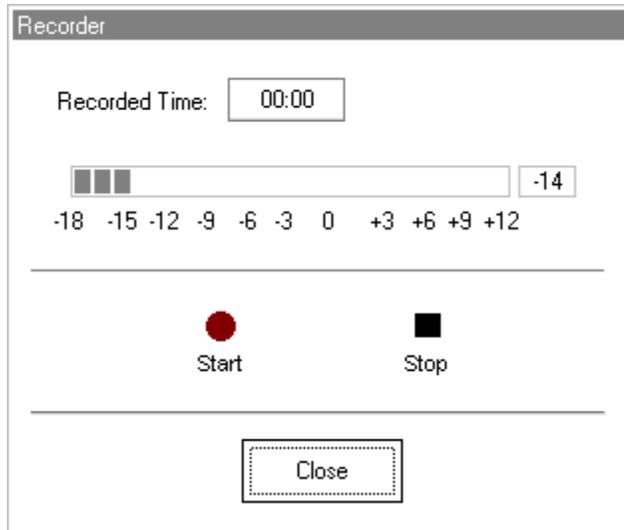


HOW TO USE THE RECORD INPUT OPTION:

- Select *Record* on the HLS control panel. A new control panel appears on the display below the audiogram.



- Click on the red circle icon.



The talkover microphone is activated, although there is no output to the speakers as yet.

Have the third party member practice speaking the intended speech sample into the microphone. Aim to peak the voice effort at zero on the active VU meter.

- When practice is successful in maintaining a consistent input level, click the *Start* icon (red circle) and begin recording.

note: you can adjust the microphone level using the Talkover volume control on the front of the Avant™.

- When finished, click the *Stop* (black square) icon.

The Record Time will be displayed to show the length of the recording in seconds.

- If you are satisfied with the recording click the *Close* icon. If you are not satisfied, simply repeat the process of recording a new sample of speech, then click the *Close* icon.

- To play the recorded speech, click the *Play* icon on the control panel.
- Allow the third party member to experience the recording under the *Normal* and *Simulate* conditions.

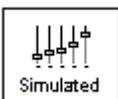


- Use the *track return* icon on the control panel to replay the recorded sample continuously.

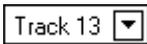
EXERCISE TWO: SIMULATE THE POTENTIAL IMPROVEMENT IN THE PATIENT'S HEARING PERFORMANCE WHEN HEARING INSTRUMENTS ARE WORN

This also provides an opportunity to set the third party's expectations for the benefits and limitations of hearing aids.

Setup



- Click *Simulated*. Select *Track 13* on the File control panel. (Make sure *File* is selected as the input signal)



Explain that you are now going to simulate the potential improvement a hearing aid can make to the patient's hearing.

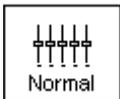
- Click *Play*.

The third party is listening to the female speaker on Track 13, adjusted for the hearing loss. Improve the patient's thresholds by applying a half gain rule to the audiogram values. Simply point and click on the audiogram to the improved threshold level.

For example: For the hearing loss entered in this lesson, you will now point and click to 10 at 250, 15 at 500 20 at 1000, 25 at 2000 and 30 at 3000,4000,6000 and 8000Hz.

You do not need to be precise in this step as you are performing a "simulation" of the potential benefit.

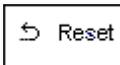
As you improve the threshold at each frequency, the female's voice becomes clearer.



- At this point, click the *Normal* icon. Explain to the third party that while you can dramatically improve the hearing performance with hearing instruments, it is still not normal hearing.



- With the track still playing, click *Simulated* again. Remind the third party that with the hearing aid, the patient hears better than without the hearing aid. To demonstrate this, click the *Reset* icon on the control panel. This resets the audiogram to the patient's original hearing loss values.



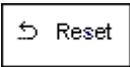
You can repeat this simulation with a variety of tracks on File.

This simulation provides the third party with the experience and understanding that hearing instruments have great potential to benefit the patient. It also helps the third party not to expect the patient to have normal hearing, even with hearing instruments.

EXERCISE THREE: USE THE HEARING LOSS SIMULATOR TO SIMULATE THE NATURAL DETERIORATION IN THRESHOLDS OVER TIME

This helps consolidate your recommendation for the patient to be fitted with the flexibility of programmable technology, which allows the hearing instrument to "grow" with the hearing loss for the life of the instrument.

It is useful to simulate the effect of a drop in the patient's hearing. Most presbycusis hearing losses are characterized by gradually declining hearing thresholds. It is not unusual to see a drop of 5 to 10dB in thresholds over a 3 year period. This simulation is used in conjunction with your recommendation to fit programmable hearing instruments that can be adjusted for changes in hearing levels for the life of the hearing aid. This adds validity to the added cost of high end program hearing instruments.



Setup

- Click *Simulated*.

Select your preferred track on File.

- Click *Play*.

Manually change the audiogram thresholds by 5 -10dB for all frequencies across the frequency range. Simply point and click the mouse to a threshold 5dB below the current threshold on the audiogram. While this does not "appear" to be a significant change on the audiogram, it is usually enough of a drop in hearing performance for the third party to hear.

- To return to the original audiogram, click the *Reset* icon.

Master Hearing Aid

It is highly recommended you use demonstration hearing aids, as master hearing aids, to introduce patients to hearing instrument technology. Providing the patient with the experience of listening to a "real" hearing instrument is a superior demonstration to a master hearing aid "simulation". However, the Master Hearing Aid provided in the Avant TM is a quick way to simulate the potential benefit of hearing instruments to a patient who has never worn hearing aids before. It is recommended you use the MHA for mild and moderate losses only.

Setup for Master Hearing Aid



- Click the *MHA / HLS* icon from the main menu screen.

The first screen is AUDIO. If you do not have a current patient record open, manually enter air conduction thresholds for one ear on the audiogram.

For the purpose of this exercise, enter the following audiogram for the *Right Ear*:

20 at 250, 30 at 500, 40 at 1000, 45 at 2000, 50 at 3000, 55 at 4000, 6000 and 8000Hz.

Enter the same values for the Left Ear.



- Click *MHA* on the taskbar.

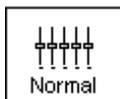


- Click *Help* and become familiar with the screen and icons for Master Hearing Aid.

Close the Help file from the X icon to return to the Master Hearing Aid exercise.



- Select *Right Ear*.



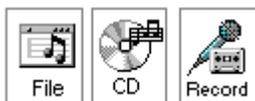
- Select *Normal*.

The program automatically reads the patient's audiogram data and plots gain curves to the display. The default gain rule applied to the thresholds is the NAL(R) rule. This rule applies well to most hearing losses for comfort level hearing.

Exceptions: For very mild hearing losses, select the 1/3 Gain rule.

For very severe hearing losses, select the 1/2 Gain rule.

A gain curve is plotted for each ear. The highlighted (green) curve is determined by which test ear icon you have selected on the control panel.



- Click either the *File* or *CD* icon. File accesses the stored audio tracks on the system hard drive. The MedRx Sounds Sensations CD is on File. If you use the CD, make sure the audio CD is in the CD ROM before selecting the CD input. This option provides you with greater variety and control of the sounds used in the simulation.

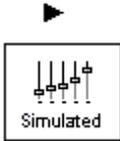


- Click *Binaural*. This allows the prescribed gain to go to each ear simultaneously, to simulate a binaural fitting.

Instruct the patient. The patient will begin by hearing the sound unchanged. When you click the Simulated icon, the patient will hear the simulated hearing aid effect on the sound.

Place the insert earphones on the patient.

Position the patient so that they can view the monitor.



- Select the desired track on File or if using the CD, select the preferred track and press *Play*.

Allow the patient to listen for a few seconds, then click *Simulated*.

Continue presenting the signal.

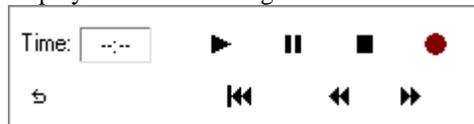
The patient should now be able to notice a significant change in the clarity of the signal.

Repeat this simulation using a variety of CD tracks.

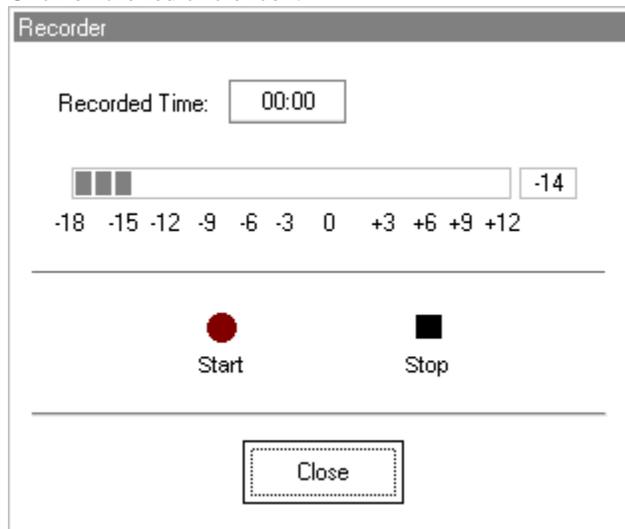


RECORD YOUR OWN STIMULUS:

- Select *Record* on the MHA control panel. A new control panel appears on the display below the audiogram.



Click on the red circle icon.



The talkover microphone is activated, although there is no output to the speakers as yet. Have the third party member practice speaking the intended speech sample into the microphone. Aim to peak the voice effort at zero on the active VU meter.

- When practice is successful in maintaining a consistent input level, click the *Start* icon (red circle) and begin recording.

note: you can adjust the microphone level using the Talkover volume control on the front of the Avant™.

- When finished, click the *Stop* (black square) icon.

The Record Time will be displayed to show the length of the recording in seconds.

- If you are satisfied with the recording click the *Close* icon. If you are not satisfied, simply repeat the process of recording a new sample of speech, then click the *Close* icon.
- To play the recorded speech, click the Play icon on the control panel.

Allow the patient to experience the recording under the *Normal* and *Simulate* conditions.

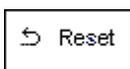


- Use the *track return* icon on the control panel to replay the recorded sample continuously.

Based on the patient's subjective response as to "how it sounds", you can make adjustments to the simulation by 1) editing the gain curves and | or 2) comparing monaural to binaural amplification.

1) Editing the Gain curve to customize the master hearing aid

Adjust to comfortable volume: If the patient does not think the Simulated mode is comfortably loud in each ear, adjust the overall volume level using the +5 or -5 icons.



Sound is too "tinny"?: If the patient reports that the signal is too "tinny", you can reduce the high frequency gain or increase the low frequency gain by editing the gain plot on the display. To do this, select the ear icon to be adjusted and simply point to the preferred level of gain on the gain curve at any given frequency and click the mouse button. The gain curve plot changes to the new level. Make appropriate changes to the other ear gain curve. Monitor the patient's response as to how it sounds. At any time, to return to the original prescription gain levels, select the *Reset* icon.

COMPARING A MONAURAL TO A BINAURAL FITTING USING MASTER HEARING AID



The Avant™ Master Hearing Aid task automatically assumes a binaural fitting and applies gain for each ear. If you want to demonstrate a monaural fitting, either as a comparison to the binaural fitting or because only one ear is aidable, click the *Monaural* icon and proceed with the simulate versus normal demonstration outlined above. The non-test ear will not receive any stimulus.

LESSON TEN

Hearing Instrument Test (HIT)

Purpose

The Hearing Instrument Test program is used to measure the hearing instrument response in a 2cc coupler in the test box. The coupler response can then be compared to the manufacturer specification to ensure quality performance or to detect possible malfunctions of the hearing instrument.

Standards

Hearing Instrument Test (HIT) provides two test standards. The default standard is the ANSI S3.22 – 1987 Revised 1996. The second standard is the IEC-118. Manufacturers in the United States almost exclusively use the ANSI standard.

The tests included in Hearing Instrument Test are explained in detail in the Help files in the program. Refer to the appropriate ANSI and IEC publications for full details of each individual standard.

This lesson assumes you are familiar with ANSI test box measurements and manufacturer hearing instrument specification information. The exercises in this lesson give you practice at setting up the hardware and software for test box measurements.

EXERCISES

EXERCISE ONE: HARDWARE SETUP FOR TEST BOX MEASUREMENTS

EXERCISE TWO: SOFTWARE SETUP FOR AUTOTEST

EXERCISE THREE: SOFTWARE SETUP FOR MANUAL TESTING FOR SPECIFIC CHARACTERISTICS OF THE HEARING INSTRUMENT

EXERCISE ONE: HARDWARE SETUP FOR TEST BOX MEASUREMENTS

The acoustic treatment in the Avant™ test box provides the ambient noise environment required for ANSI standard testing. Always perform test box measurements with the lid closed.

Make sure the coupler microphone and test box reference microphone are plugged into their locations. Refer to the Installation manual provided with the Avant™.

Hearing Instrument setup

Before placing the hearing instrument in the test box for an ANSI test, it should be adjusted to these basic settings, as specified in the standard:

- Tone control settings shall be chosen to give the widest frequency response range.
- All other controls (except user operated gain control – which is set to full-on for the Autotest) shall be set to give the greatest HFA-OSPL90 ... and the highest HFA full-on gain.

- For AGC aids, the manufacturer specifies the AGC settings required to test the aid.

Note all settings, so the results can be reproduced.

Adjust the hearing instrument according to the above and then position the hearing instrument as described below for the type of hearing instrument to be analyzed.

Coupling the hearing instrument to the testbox

Custom ITE (In The Ear) and ITC (In The Canal) Hearing Instruments

- Make sure that the 2cc coupler is attached to the coupler microphone located in the test box.
- Set the hearing instrument controls as explained above, with the gain and volume controls full-on.
- Connect the hearing instrument directly to the cavity of the ITE snap-on piece for the 2 cc coupler. The connection between the hearing instrument and the coupler shall be made tight by using a hermetic sealing material such as Bostik Blu-Tack. Measurements should be performed with all the acoustic coupling vents sealed. Make sure that the sound bore is directed through the opening of the ITE coupler piece. Take care to avoid the inclusion of extraneous cavities which might affect the performance of the hearing instrument.
- Attach the ITE snap-on piece with attached hearing instrument to the 2cc coupler.
- Plug in the appropriate battery simulator in the right hand side of the test box. Put the battery simulator pill into the battery compartment of the hearing instrument.
- Position the assembly in the test box and place the reference microphone at a distance of a maximum 5mm from the microphone of the hearing instrument. Take care that the two microphones are placed at a right angle in relation to the loudspeaker.
- Optional: To test whether the custom instrument canal has been hermetically sealed to the 2cc coupler, you may perform a test SSPL-90 measurement with the hearing instrument turned off. The resulting occluded coupler response should always be less than 90 dB SPL within the frequency range of interest.
- Turn on the hearing instrument.
- Close the lid of the test box. You can now proceed to perform measurements.

BTE (Behind The Ear) Hearing Instrument

- Make sure that the 2cc coupler is attached to the coupler microphone located in the test box.
- Set the hearing instrument controls as explained above, with the gain and volume controls full-on.
- Connect the hearing instrument to the BTE snap-on coupler piece by means of a flexible tube. Unless otherwise specified, the length of the flexible tube measured from the end of the elbow or from the end of the nub to the entrance of the 2cc coupler pipe stub shall be 20 +/-1 mm.
- Position the assembly in the test box as indicated with white ink on the bottom plate of the box.
- Snap the BTE piece with the attached hearing instrument onto the 2cc coupler.

- Plug in the appropriate battery simulator in the left side of the test box. Insert the battery simulator pill into the battery compartment.
- Turn on the hearing instrument.
- Close the lid of the test box and proceed to perform measurements.

Body Worn Hearing Instrument

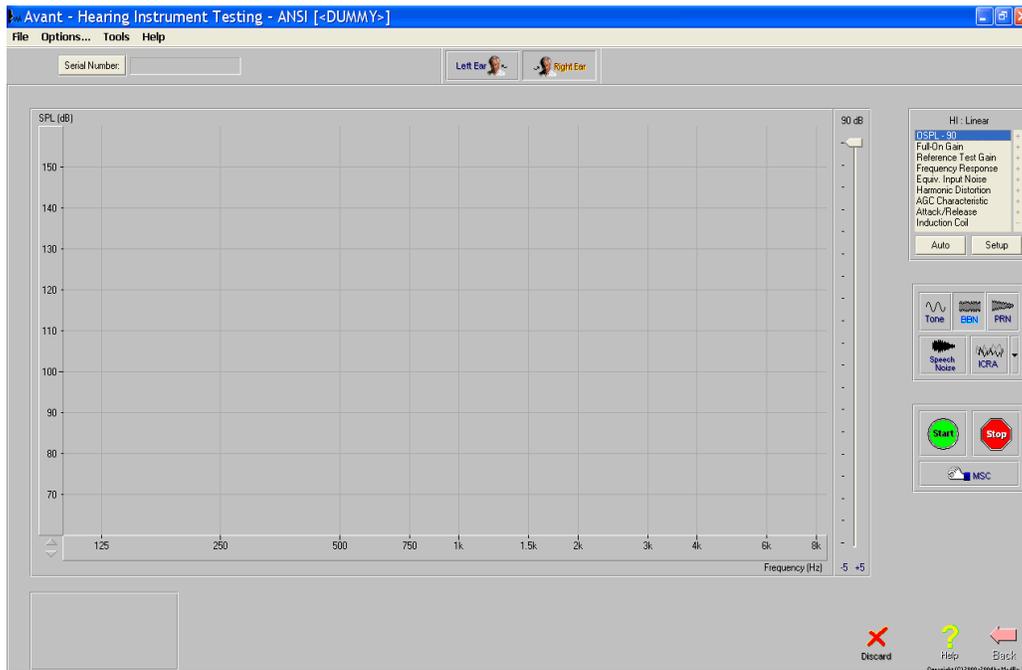
- Make sure that the 2cc coupler is attached to the coupler microphone located in the test box.
- Set the hearing instrument controls as defined above, with the gain and volume controls full-on.
- Connect the hearing instrument earphone to the BODY snap-on coupler piece. The connection between the hearing instrument and the coupler shall be made airtight by using a hermetic sealing material such as Boseki Blu-Tack.
- Position the assembly in the test box and snap on the BODY coupler piece to the coupler.
- Place the reference microphone at a distance of maximum 5mm from the microphone of the hearing instrument. Take care that the two microphones are placed at a right angle in relation to the loudspeaker.
- Remove the battery simulator plug from the socket in the test box. It cannot be used with body-worn hearing instruments.
- Turn on the hearing instrument.
- Close the lid of the test box and proceed to perform measurements.

EXERCISE TWO: SOFTWARE SETUP FOR AUTOTEST

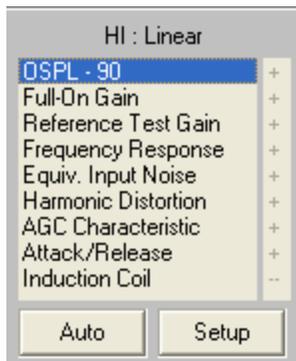


HIT offers a quick and accurate Autotest mode to perform a sequence of tests selected in Setup.

- Click *HIT* on the main menu screen.



- Click *Setup* on the control panel.



The test setup screen displays a list of Unselected and Selected tests. To move a test from one column to another, click on the test description and then the *arrow* icon pointing in the direction you want to move the test to.

Enter information for the Hearing Instrument type and slope, battery type and test frequency for input/output AGC test.

- Click *OK* to close the test setup screen.

Each selected test has a + sign next to it's description on the control panel. Each Unselected test is indicated by a - sign.

Make sure the hearing instrument controls are set to the required positions and the instrument is attached to the testbox.

- Click *Auto*.

The system automatically performs each test selected in setup. The system will pause at the Reference Test Gain to allow you to reset the volume control to the reference test gain position. It will also pause at the Telecoil measurement, if selected, to prompt you to move the switch to the "T" position.

As the program performs each measurement, the corresponding data screen appears on the display. As the system is rapidly performing the measurements, you will not see the result on the screen during the test.

To **view** the measurement data, wait until Autotest is complete.

Click on the test description on the control panel to display the data measured in the Autotest.

Compare the screen measurements with the manufacturer specifications.

To keep a copy of any HIT measurement, select the measurement to display the data on the screen and print from File on the toolbar.

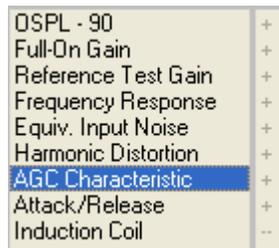
The HIT data is not stored to the patient's file.

EXERCISE THREE: SOFTWARE SETUP FOR MANUAL TESTING FOR SPECIFIC CHARACTERISTICS OF THE HEARING INSTRUMENT

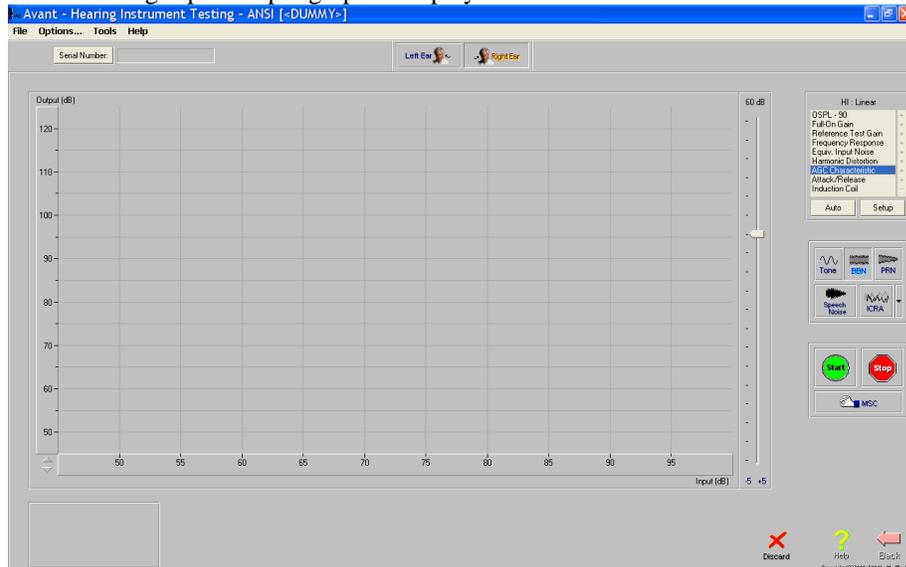
To perform a test box measurement for any test in the standard, select the test from the list on the screen, the stimulus to be used and START.

For example:

Click *AGC Characteristic*



The following Input/Output graph is displayed.



Select *STOP* to interrupt a measurement. Otherwise the stimulus will automatically switch off when the measurement is complete.

The measured data is plotted to the display in real time for quick monitoring.