IHaff
A Comprehensive Hearing Aid Fitting Protocol

IHaff
Independent Hearing Aid Fitting Forum:

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PERSPECTIVE:

The Independent Hearing Aid Fitting Forum was formed as a result of the frustration felt by many audiologists who recognized a gap between technology development and the tools available for selection, fitting and verifying the performance of hearing aids.

The members agreed to assemble in March of 1993 in Denver and discuss strategies for developing comprehensive hearing aid selection, fitting and verification of benefit protocols. The group developed a framework of ideas to build upon individually until the next meeting which was held the following July in Chicago. Further work was completed in Tampa in October, in November in Anaheim, and Chicago in March 1994.

We have not addressed the crucial issues of counseling, mechanical adjustment, and aural rehabilitation. These areas are probably the most important aspect of any hearing aid fitting, but are beyond the scope of our project. We are striving to provide a workable protocol that will allow us to make better use of the features available to us in contemporary hearing aids.

We also have not addressed the multitude of electroacoustic and mechanical features that are available in contemporary hearing aids. Directional microphones, remote controls, digital volume controls, direct audio input capabilities, etc. are important to individual hearing aid fittings, but are best selected by the clinical and practical sense of the dispenser, rather than dictated by protocol.

We believe that any hearing aid fitting should begin with the following goals:

>Soft sounds and soft speech, in as wide a bandwidth as practically possible, should be audible.

>Levels of speech and environmental sounds that are comfortably loud for normal hearing listeners should be amplified so that they sound comfortable.

>Loud sounds and loud speech should not be uncomfortable.

>The hearing aid system selected to meet the desired amplification goals should meet strict standards for a minimum of circuit noise and distortion at typically encountered input levels.

In addition to considering hearing thresholds, the fundamental basis for much of our work has focused on suprathreshold measures. The consensus of the IHAFF group was that sufficient evidence had accumulated both here and abroad to justify a loudness-based approach.

To assist in preselection decisions, and to assess the perception of communicative difficulty, the IHAFF protocol includes software assisted methods for loudness judgement measures, selection of specific
electroacoustic characteristics of hearing aids, and for a self-assessment questionnaire that is useful before and after the fitting. The employment of software assistance allows for consistent and efficient selection and evaluation methods. Components of the protocol may, at first, appear too imposing and complex to be implemented by many dispensers. We recognize the complexity and the reality faced in a busy clinic or office. The IHAFF software, which will be distributed at no cost, will effectively reduce the complexity and workload of the dispenser.

The protocol recommends steps that may take more time than is currently being spent for most fittings. The IHAFF members recognize that there are practical limitations in the real-world implementation of any procedure, and we do not expect our experienced colleagues to abandon good clinical sense in the implementation of our suggestions. In many cases, it may be impractical or unnecessary to follow the entire protocol, especially if it is apparent that time is better spent in counseling or training the user in mechanical management of the hearing aid. (No one should think the IHAFF committee members are so out of touch with reality that they themselves wouldn't spend an extra 20 minutes explaining how to insert the battery when required, rather than attempting sophisticated loudness tests on someone who might require 20 minutes to acquire a proper understanding of the loudness judgement task itself.) However, if the protocol is followed, we believe that the result will be an excellent starting point for a hearing aid fitting that addresses the key electroacoustic needs of the user.

INTRODUCTION

The process of fitting hearing aids has changed over the past several years, largely because of the influence of prescriptive formulae and real-ear measurements. Prescriptive methods have proven to be rather successful for fitting linear amplification. They fall short, however, when nonlinear circuitry is used, because those devices provide differing amounts of gain across input levels. The introduction of programmable hearing aids that offer control of compression threshold, compression ratio, and release time further complicates this issue, and will require the hearing aid dispenser to play a much greater role in the fitting process than with conventional hearing aids. A comprehensive fitting protocol based on current research and knowledge is needed to assist in the goal of optimizing the benefit derived from a given hearing instrument system.

The Independent Hearing Aid Fitting Forum (IHAFF) team is striving to develop a working protocol that will standardize the process of fitting hearing aids and respond to the challenges presented by programmable and nonlinear technology.

One focus was not to develop new test procedures, but rather to develop a standardized comprehensive protocol that takes advantage of the broad base of knowledge and skills applied by successful clinicians. The IHAFF team recognizes that limitations on cost and time exist for most
clinicians, thus the fitting and evaluation guidelines were designed to be comprehensive in scope, yet realistic with respect to the pragmatics of hearing aid dispensing. As a result, the entire initial evaluation and fitting procedure can be accomplished in approximately 1.5 hours, and equipment requirements are not restricted to a specific make or model. The process will be expedited with the assistance of the IHAFF software which will carry out mathematic computations, displays and correction factors.

The critical verification of this recommended procedure will occur during feasibility trials. Millions of hearing instruments have been successfully fitted with acceptable, if not excellent, benefit to consumers without a comprehensive universal protocol. The fact remains, however, that there is a steady 15% to 20% return for credit faced by hearing aid manufacturers (MarketTrak III, 1992). These hearing aid return rates probably underestimate the number of people who obtain some benefit from hearing aids, but who are dissatisfied overall with hearing aid performance. There is no assurance that a standardized protocol of any type will improve the situation, but improved consistency should make it easier to identify the factors that contribute to returns and dissatisfied users.

**RATIONALE FOR HEARING AID SELECTION METHOD**

The hearing aid selection method assumes that an optimal hearing aid fitting will result from amplification that acts to restore normal loudness relationships among environmental sounds, including speech at various typical input levels. This assumption is not fully tested.

It is obvious that, in daily life, listeners are exposed to speech inputs at a variety of levels (for example, consider the level of speech produced in a library and that produced at a cocktail party). It is not clear at this time what levels should be used to characterize these varying inputs. For the present, the following data have been used: Soft speech is taken as 5 dB lower than the levels produced by talkers speaking with "casual" vocal effort; average speech is derived as the mean levels of "normal" and "raised" vocal effort; loud speech is set to an overall level of 85 dB SPL, which is about 5 dB higher than the mean levels of talkers speaking with "loud" and "shouted" vocal effort. The 1/3-octave band spectra of speech at the three levels were determined from data in 1/3 octave bands reported by Pearsons, Bennett, and Fidell (1977), and Pavlovic (1993).

Although speech is the input signal of primary interest, it is not practical to measure loudness perception for frequency-specific speech signals. Therefore, loudness perception is measured for band-limited stimuli such as warble tones or noise bands. A standardized psychoacoustic procedure is used. Loudness perceptions are categorized in terms of a seven-point scale (Appendix B). Categories 1-3 are combined to define the range of "soft" perceptions, categories 3-5
define the range of "comfortable" loudness, categories 5-7 outline the boundaries of "loud" perceptions. It is important to remember that these loudness perceptions apply to pulsed warble tones only. It cannot be assumed that the same levels of other types of sounds (such as speech) would elicit the same loudness judgements.

The relationships between soft, comfortable and loud perceptions for the pulsed warble tone stimuli and soft, average, and loud speech input levels (in 1/3 octave bands) have been established for normal-hearing listeners at several test frequencies (Cox, Goff, Martin, and Mcloud, 1994). The hearing aid selection method assumes that if amplification re-establishes these relationships for the hearing impaired listener, loudness perception for many environmental sounds will approximate those experienced by typical individuals with normal hearing. The following table describes the relationships.

<table>
<thead>
<tr>
<th>Hz.</th>
<th>Soft</th>
<th>Average</th>
<th>Loud</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>.001(s)</td>
<td>.5(s)</td>
<td>.87(s)</td>
</tr>
<tr>
<td>500</td>
<td>.39(s)</td>
<td>.9(s)</td>
<td>.48(c)</td>
</tr>
<tr>
<td>1000</td>
<td>.24(s)</td>
<td>.85(s)</td>
<td>.67(c)</td>
</tr>
<tr>
<td>2000</td>
<td>.29(s)</td>
<td>.82(s)</td>
<td>.64(c)</td>
</tr>
<tr>
<td>3000</td>
<td>.27(s)</td>
<td>.82(s)</td>
<td>.59(c)</td>
</tr>
<tr>
<td>4000</td>
<td>.26(s)</td>
<td>.71(s)</td>
<td>.50(c)</td>
</tr>
</tbody>
</table>

Table 1. The relationships between loudness judgements for pulsed warble tone stimuli and typical speech input levels. Each entry gives the speech input level in terms of proportion, from the bottom, of the soft (s) or comfortable (c) loudness range for warble tone stimuli. These values define the target levels for amplification. For example, in a speech signal of average level, the 1000 Hz. 1/3-octave band should be amplified to a point that is .85 of the range of "soft" judgements for warble tones (Measured from the bottom of the range).

The software program VIOLA (Visual Input/Output Locator Algorithm) (Cox, Taylor, Gray and Brainerd, 1994) has been written to facilitate selection of circuit parameters that achieve these amplification goals. The dispenser enters the results of the loudness perception test for the hearing aid candidate. The program then displays two input/output graphs at frequencies chosen by the dispenser. The displays show
target values for the three speech input levels. The dispenser enters
gain, compression ratio, compression threshold, and limiting levels of
known circuits, and inspects the resultant calculated input/output
curves for a match with the target values.

IHAAFF PROTOCOL

I. Prefitting Data Collection

The basic comprehensive audiometric evaluation (air, bone, speech
audiometry, and immittance measures) is recognized as a fundamental
requirement prior to collection of other, more specific measures for
hearing aid fittings, and serves to identify any need for medical
treatment. The following procedures are outlined with the assumption
that a comprehensive evaluation has been competently completed.
Additional loudness judgment measurements may permit substantially
better hearing aid fittings now that contemporary hearing aids allow us
to make use of the additional information. Restoration of normal
loudness appreciation results in amplified speech cues that are audible
for soft inputs, comfortable for normal speech levels, yet not
uncomfortable or distorted for intense sounds.

Knowledge of SPL<sub>2cc</sub> for threshold, comfort, and discomfort levels is
critical for determining and accurately providing desired levels of
amplification. Insert earphones are recommended for accuracy and ease
of conversion to HA1 2cc measures. The following procedures are
recommended:

A. Pure tone thresholds.

Audiometric thresholds should be determined for the range from 250 to
8000 Hz, including octave and intra-octave thresholds as necessary for
the configuration of the hearing loss.

1. Convert thresholds from HL to HA-1SPL<sub>2cc</sub>:

   Purpose: Threshold measures expressed in SPL<sub>2cc</sub> permit
   rapid and simplified determination of desired hearing aid
   characteristics because of the common reference
   point. Properly calibrated insert earphones will yield
   the desired accuracy for determining SPL<sub>2cc</sub>.

   Conversion Method:
   Add the 2cc coupler reference threshold correction to
   the audio-meter dial reading at threshold. (Table G.2
Example of threshold 2cc conversion:

<table>
<thead>
<tr>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
<th>4000</th>
<th>6000</th>
<th>8000</th>
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<tr>
<td>30</td>
<td>35</td>
<td>45</td>
<td>55</td>
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<td>70</td>
<td>75</td>
<td>80</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dial</td>
</tr>
<tr>
<td>15.5</td>
<td>8.5</td>
<td>3.5</td>
<td>6.5</td>
<td>5.5</td>
<td>1.5</td>
<td>-1.5</td>
<td>-4</td>
<td>Corr2cc</td>
</tr>
<tr>
<td>45.5</td>
<td>43.5</td>
<td>48.5</td>
<td>61.5</td>
<td>70.5</td>
<td>71.5</td>
<td>73.5</td>
<td>76</td>
<td>SPL2cc</td>
</tr>
</tbody>
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Note: The IHAFF software will perform the above conversions from HL insert phones to HA1 SPL2cc.

B. Loudness Growth Judgments.

The objective is to define an approach for measuring loudness perception that is reliable, clinically feasible, and widely used. To that end, a well-defined instruction set is critical (see Appendix A), should be provided in written form, and verbally explained as appropriate. Further, a software driven automated test procedure will yield consistent results and simplify the dispensers role. The IHAFF software has been designed to include an automated procedure and drivers for audiometers.

1. Stimuli

Frequency-specific stimuli should be used, with a preference for warble tones over narrow-band noise for patients with precipitous losses. Stimulus duration may be gated manually, or pulsed through the audiometer. A minimum of two frequencies should be used for assessment of loudness growth; the recommended frequencies for this approach are 500 Hz and 3000 Hz., or more appropriate frequencies depending upon the configuration of the hearing loss. 500 and 3000 Hz. most likely represent the regions of maximum output for the low- and high-frequency bands of multiple-band compression instruments, and

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1 To the extent that insert-earphone audiometry gives the same results as supra-aural earphone audiometry, the above table applies for audiometric data using either type of transducer. It is expected that insert-phone audiometry will yield results of the highest accuracy for the purpose of fitting hearing aids according to this protocol, especially when the insertion depth is carefully matched between the earphone and the hearing aid earpiece.

2 If the filter characteristics (bandwidth, filter slope) and calibration of narrow-band noise stimuli are known, narrow bands may also be appropriate for use.
are also appropriate for most contemporary single channel broad band instruments. Measurement of additional frequencies will obviously add precision to the measure of an individual's loudness function. Two frequencies represent the minimum necessary for the fitting procedure.

2. Procedure

Present the stimuli via insert earphones\(^3\). Thresholds must be converted to SPL\(_{2cc}\) using the method defined above for threshold measurements. Prior to the actual test, a practice run should be completed. For a selected frequency, the patient's task is to respond to varied presentation levels on a seven-point scale of loudness (Appendix B). Starting at threshold, use an ascending approach in 5 dB steps (or 2.5 dB steps for listeners with narrow dynamic range) until an "uncomfortably loud" response is obtained. Return to threshold, and repeat for a minimum of three runs. Currently the recommended methodology assumes that the median of values obtained on four runs may be assumed to represent the loudness percept in each category. The purpose of these measures is to define HA-1 2cc SPL values for each of the 7 loudness categories.

C. Index of communicative handicap.

Informal interview may be a more familiar technique for gaining an understanding of a patient's needs and expectations, but a formal subjective method is also required to obtain data for comparisons to others with hearing loss and can also provide a baseline for charting progress. A well documented and standardized method similar to the Abbreviated Profile of Hearing Aid Benefit (APHAB), developed by Cox and Alexander (1994), is recommended. This 24 item computer-based approach is divided into four subscales: Easy listening speech, Speech in noise, Reverberation, and Reaction to environmental sounds. The results may be compared to normative data collected by Cox, Gilmore, and Alexander, (1991). The results can be used to assess the individual patient's needs and expectations from amplification, and to establish a baseline for comparison to aided conditions.

II. Hearing Aid Selection

To two traditional hearing aid fitting goals (1.)making soft speech sounds audible and (2.)high-intensity sounds loud but not uncomfortable, we have added a third measurable goal: (3.)maintaining normal conversational speech within the individual's comfortable

\(^3\) Use of insert phones allows ease of conversion to express 2cc coupler values in terms of HA-1 calibration.
listening range. The committee assumed that if a fitting procedure meets these objectives across an appropriate bandwidth with minimal distortion, the typical hearing aid user should not only receive appropriate cues for good speech intelligibility, but should also experience good speech quality. The preferred mode of amplification is binaural.

**Recommended Method:**

The rationale for the circuit selection process is based on the loudness growth information. Casual, normal and loud vocal effort speech levels are targeted to fit appropriately within the individual's seven categories of loudness. If the minimum of two bands are computed, the resultant input/output curves define the gain, slope, and output of the desired hearing aid. In general, loudness percepts for warble tones are used to determine dynamic targets for various levels of speech. Microphone location, loudness summation and other factors are considered in the equation to derive the desired input/output functions.

Because of the number of variables to consider in the circuit selection process, computer assistance dramatically facilitates the task. Cox has introduced a program, *Visualization of Input/Output Locator Algorithm* (VIOLA) and developed software which allows for calculating the relationship between overall speech input levels for soft, average and loud speech at the hearing aid microphone, and the user's individual loudness judgments for warble tones. The software developed by Cox et al. displays individual loudness judgment categories along with an input/output graph (see figure 1) noting input (30-90 dB in 10 dB increments) at the hearing aid microphone vs. output of the hearing aid as measured in an HA-1 2cc coupler. A matrix array within the VIOLA software allows the dispenser to enter different combinations of: a) overall gain at an input level of 40 dB, b) output, and c) compression characteristics (Threshold kneepoint and compression ratio) at the frequencies for which loudness judgments were measured. The calculated input/output curve is then displayed on the input/output graph and inspected by the dispenser for agreement with the prescribed "target". If the calculated curve does not meet the desired specifications, modifications to the data in the matrix array can be applied to achieve a better "match". The final product of the VIOLA program will be specific input/output curves by frequency for the desired hearing aid. The software corrects for different microphone locations depending on the type of instrument (ITE, BTE, ITC, CIC).

The dispenser's decision as to the type of circuitry is facilitated by the input/output curve displays. The needs for linear with output compression, input compression, full dynamic range, adjustable compression kneepoint, compression ratio, etc. are evident once familiarity with the displays is achieved.
It is possible to perform a similar process without computer assistance. A manual procedure was independently developed by Bentler at the University of Iowa. The unpublished work was developed to assist students in the selection of appropriate gain and compression characteristics for hearing aid fittings.

III. Fitting and Verification
The primary goals of this phase are to verify that the fitting objectives have been met for soft, average, and loud speech, and also to be certain that intense environmental sounds do not reach loudness discomfort levels. It will be necessary to verify the initial hearing aid adjustments with 2cc coupler measures, aided soundfield measures, and probe microphone assessment. Validation will assess whether the fitting has resulted in a hearing aid fitting that the user perceives as beneficial.

A. Preliminary 2cc coupler adjustments:

1. preset the hearing instrument in the coupler so that the input/output curves meet the specifications as determined in the hearing aid selection phase of the protocol. Appropriate reserve gain should be available in addition to the use setting gain.

2. Run an ANSI S3.22 test sequence, as well as other applicable coupler tests, paying particular attention to the following:
   a. The maximum hearing aid output must be appropriate. Ensure that the 2cc SSPL90 hearing aid response is such that levels equivalent to a loudness rating of 7 are not reached. Assessment of SSPL90 may be necessary at different volume control settings, depending upon the type of hearing aid circuit.

   b. Distortion levels at use settings should be verified to be within the manufacturer's specified limits, and no more than 10 (90 dB input) for new users.

B. Aided measures:

1. Conversational speech: Present conversational speech (65 dBSPL)⁴ and ensure that it is perceived at a loudness rating of 3, 4, or 5.

2. Low level sounds: Measure sound field thresholds. Responses should fall in the 20 to 30 dBHL range if soft speech is to be audible. (The goal is 20 dBHL with an allowance for thresholds to be 5dB greater for each 10 dB of loss over 60 dBHL.) Probe microphone insertion gain measures may be used in lieu of

⁴ Frequent peaks on the VU meter
functional gain if stimulus presentation level does not exceed the AGC threshold of the hearing aid.  

3. High level speech: Present high level speech (85dB SPL), and ensure that it is perceived at a loudness rating of 6.

4. Probe microphone measures:

a. Observe the Real-ear aided (REAR) frequency response curve to ensure no excessive irregularities (peaks), and to verify that the bandwidth is as wide as practical for the user.

b. Measure the RESR a swept warble-tone or smoothed pure-tone stimulus at 90 dB SPL to verify that a loudness discomfort rating of 7 is not reached at any frequency. If real-ear-to-coupler difference (RECD) measurement is available, observe the SPL in the ear canal and compare with loudness judgment levels obtained earlier as an additional check. (Add the RECD to the HA-1 2cc values first to transfer them to real-ear SPL values.) The reader is referred to Mueller, Hawkins, and Northern for detailed conversion methods.

5. Discomfort checks: At volume control settings expected for use, present real-life obnoxious sounds such as paper crumpling, rocks in a coffee can, pig calls, etc. to ensure that the user can tolerate excessive sound levels. Adjust SSPL90 as necessary.

IV. Validation of Hearing Aid Benefit

Validation of user benefit and satisfaction is an important but frequently overlooked component of the hearing aid evaluation process. Objective measures such as sound field thresholds and probe mic measures have sufficed for validation measures in the past, but they do not measure satisfaction, nor do they predict the patient's ability to understand speech in noise.

The validation strategies must fit within the framework of a 30-day trial period. Validation of benefit should be an ongoing process. Validation measures should be accomplished after two to four weeks, to allow some adjustment, but within the 30-day trial period.

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5 Error can be expected with this method to the degree that open ear response and middle ear impedance differ from the adult average.
A. Speech recognition tests.

The IHAFF Committee has no recommendations on specific speech tests. While it may not be necessary for the validation of all fittings, a clinically applicable speech-in-noise test that assesses performance for both soft and loud speech would be helpful. Recently developed tests are currently under evaluation.

B. Self-assessment of hearing aid benefit.

There are several measures to choose from, but the APHAB (Cox & Alexander, 1994) was selected for use with the IHAFF procedure because:

a. Normative data exist for persons with hearing loss;

b. Responses may be entered for both aided and unaided conditions;

c. Good clinical utility exists, because the test may be administered and scored via computer or manually with paper and pencil.

Patient responses from the APHAB may be compared to those collected from the unaided condition to determine the degree of perceived benefit provided by amplification.

V. Conclusions

Use of the IHAFF fitting procedure should improve the selection process, and have a beneficial effect on user satisfaction with hearing aids over those procedures in current use.

It is important to recognize that this protocol is a beginning, and not a finished product. We believe that the basic premises are sound, but we expect that there will be changes in the recommendations as we proceed with the feasibility studies this year. This document is not meant to be a tutorial on all the components, but an overview of the basic conclusions reached thus far.
Appendix A:

Instruction set for loudness test

THE PURPOSE OF THIS TEST IS TO FIND YOUR JUDGMENTS OF THE LOUDNESS OF DIFFERENT SOUNDS.

YOU WILL HEAR SOUNDS THAT INCREASE AND DECREASE IN VOLUME. YOU MUST MAKE A JUDGMENT ABOUT HOW LOUD THE SOUNDS ARE. PRETEND YOU ARE LISTENING TO THE RADIO AT THAT VOLUME. HOW LOUD WOULD IT BE?

AFTER EACH SOUND, TELL ME WHICH OF THESE CATEGORIES BEST DESCRIBES THE LOUDNESS.

KEEP IN MIND THAT AN UNCOMFORTABLY LOUD SOUND IS LOUDER THAN YOU WOULD EVER CHOOSE ON YOUR RADIO NO MATTER WHAT MOOD YOU ARE IN.

Appendix B: (Based on Hawkins et al., 1987)

CATEGORIES OF LOUDNESS

7. Uncomfortably loud
6. Loud, but okay
5. Comfortable, but slightly loud
4. Comfortable
3. Comfortable, but slightly soft
2. Soft
1. Very soft

References


Cox, R.M., Goff, C.M., Martin, S.E. and Mcloud, L.L. "The contour Test: Normative Data". Presented at the American Academy of Audiology Convention, Richmond, VA, April, 1994


If you read nothing else, please look at this!

IHAFF Working Protocol and software

The IHAFF hearing aid selection and fitting protocol is a proposed method for the selection of amplification for hearing aid candidates. The selection methods are based on research, common sense, contemporary knowledge, with a few completely untested principles thrown in. The software and protocol is offered as such. It should be viewed as a basis for rethinking the way hearing aid circuit processing is selected. This protocol is not offered as a final answer, but as a beginning for a different way of thinking about hearing aid fitting.

Equipment Requirements

- Diagnostic Audiometer with warble tone capabilities, and (Highly recommended) Insert phones and calibrated soundfield capabilities.
- Electroacoustic analyzer with ANSI 2cc coupler capabilities. A probe microphone system is desirable, but not required.
- IBM compatible PC with one parallel port and at least one serial port (two if using a mouse). 500K of hard disk space and 450K RAM are required to install and run the program.
- If you plan to have the software "Drive" an audiometer for loudness judgement testing, one of the following instruments with a computer interface will be required:
  Beltone 2000
  Frye 3100
  Frye FA-10
  GSI 10
  GSI 16
  Madsen OB 822
  (Loudness judgements may be collected manually, a computer driven method is not required.)
- An open mind.

Getting Started: A Few Basics

From the C:\> prompt:  Create a subdirectory named "IHAFF" by typing "MD IHAFF" and enter. then type "CD\IHAFF" (enter). "C:\IHAFF>" should appear. Put the Program disk in the A (or B) drive and type "copy A(orB):*." If things are working, you will see a listing of the files as they are copied.
When the copy process is finished, type "CAV" (CAV stands for Contour; APHAB; VIOLA), and you are on your way! Follow the README Documentation to familiarize yourself with the particulars of the program.

The VIOLA program has the capability to display various input output responses of theoretical hearing aids entered in the display matrix. Keep in mind that our selection of available hearing aid circuit characteristics is limited by the offerings of the manufacturers. A realistic approach in using the VIOLA program is to enter hearing aid characteristics of instruments that can be ordered or programmed rather than trying to achieve a "Perfect match" by entering unavailable parameters.

The VIOLA data matrix has two compression threshold fields, and two compression ratio fields. Manipulation of the data allows the emulation of a curvilinear type input output function seen on some instruments today.

Good Luck!
README FILE FOR IHAFF SUITE (v. 1.0c)

In addition to this "readme" file this disk contains the files needed to run the IHAFF SUITE program:

- CAV.EXE
- CAV.HLP
- LJ.INI
- LJ3R.INI
- LJ3R.BGI
- FX.BGI
- LJ4.INI
- LJ4.BGI
- EGA.BGI
- EGA.BGI
- FRYERS.COM

The FRYERS.COM file is for use with a Frye audiometer, Model FA-10. It must be loaded before initializing the IHAFF SUITE. To do this, change to your IHAFF SUITE subdirectory and type "fryers" to load that file. You may then load the SUITE.

The IHAFF SUITE program consists of three subprograms:

**the Contour Test for loudness mapping
**the Visual Input Output Locator Algorithm (VIOLA)
**the Abbreviated Profile of Hearing Aid Benefit (APHAB):

Several screen graphs produced by this program cannot be printed. A hard copy of these can be obtained through the use of an appropriate screen dump program. One such program, SNAP, is shareware and can be ordered for $10.00 from JEMSSoftware, 41 Twin Falls Road, Berkeley Heights, NJ 07922.

DOCUMENTATION OUTLINE

SYSTEM REQUIREMENTS
Describes hardware requirements and creation of subdirectories for the program.

RUNNING THE IHAFF SUITE
Contains basic directions for navigating and interacting with the program.

FILE OPTION  (MAIN MENU)
Describes options on this submenu including creating a file, loading an existing file, saving a file, making a copy of a file, and exiting the program.

PATIENT INFORMATION OPTION  (MAIN MENU)

CONTOUR, VIOLA, and APHAB OPTIONS  (MAIN MENU)

SETUP OPTION  (MAIN MENU)
Contains options used to configure the program for hardware and software choices including printer setup, audiometer setup, and program directories (the computer paths).
STIMULUS  (CONTOUR MENU)
Describes the setup for the Contour test stimulus parameters inclu-
ding patient thresholds, audiometer correction factors, response
time, and choice of threshold units.

TEST   (CONTOUR MENU)
Describes Contour test administration.

PRINT  (CONTOUR MENU)

GRAPH  (CONTOUR MENU)

MAIN MENU   (CONTOUR MENU)

CONFIGURE  (VIOLA MENU)
Contains options used to configure patient-specific information
including the selection of the two frequencies to be graphed for
each ear and selection of the type of hearing aid. Directions for
editing data is also included.

GRAPH  (VIOLA MENU)
Contains directions for interacting with the VIOLA screen graph.

PRINT  (VIOLA MENU)

MAIN MENU   (VIOLA MENU)

QUESTIONNAIRE   (APHAB MENU)
Contains options to enter patient information and to choose either
clinician edit or patient edit for questionnaire administration.

OPTIONS   (APHAB MENU)
Describes options to display screen graphs and to print results.

MAIN MENU   (APHAB MENU)

SYSTEM REQUIREMENTS
The IHAFF SUITE can be run on any IBM-compatible PC with one
parallel port and at least one serial port (two serial ports if
using a mouse). Create a subdirectory on your hard disk from which
to run the program. For example, create a subdirectory named "IHAFF"
off the root directory, resulting in the path "C:\IHAFF". Then
change to this subdirectory before copying the program files from
the floppy disk. You must have at least 500K free hard disk space
to install this program and at least 450K of free RAM to run it.
Data files are automatically given a .CAV extension and are initially saved in the same subdirectory as the program files. However, it is advisable to create a subdirectory separate from the program files in which to store individual data files. For example, create a subdirectory named "PATIENTS" off the program directory, resulting in the path "C:\IHAF\PATIENTS". Data files take up approximately 4K of space each.

RUNNING THE IHAF SUITE

Typing "CAV" at the DOS prompt will load the program. The Main Menu appears at the top of the screen. To select a menu item, either click on it with the mouse or simultaneously type <Alt> and the highlighted letter of the menu selection. Example: <Alt>+F produces the "File" submenu. To move about the menu levels or across the main menu items, you can use the mouse or the cursor (arrow) keys. At the bottom of the screen, there are notations which either give directions or explain options. The user can also access a Help file regarding the different program items by pressing the F1 key. <Alt>+X exits the IHAF SUITE program.

For menu options which require input from the user (such as "File" and "Setup"), the user interacts with a screen called a "dialog box". In any dialog box, moving around the various fields is done with the mouse or the <Tab> key. Additionally, anywhere in the program where <Tab> moves you around, <Shift>+<Tab> moves you in the opposite direction. Moving within a field is done with the mouse or the cursor keys. In most cases, pressing <Enter> activates the "OK" button which saves any edits made in the dialog box, and pressing <Esc> activates the "Cancel" button which does not save any edits. Pressing <Esc> or <Enter> or selecting "Cancel" or "OK" while any dialog box is displayed will return the user to the Main Menu. In dialog boxes there are four different forms of input:

1) ( ) - a radio button - highlight your selection and then leave the field. Only one selection can be made.

2) [ ] - check boxes - highlight your selection and press the spacebar to toggle the selection on/off. Any number of selections within the field can be made.

3) input lines - blank lines for text, such as comments, Patient name, etc.

4) push buttons - such as "OK" and "Cancel", highlight and press <Enter>, click on the button with the mouse, or press <Alt>+ the highlighted letter.

FILE OPTION (MAIN MENU)

Create a new file:
To create a new data file, type in the filename (up to 8 charac-
Load an old file:
Selecting this option allows users to load a previously stored file. Choose the file to open either by typing the filename or by highlighting the filename in the "Files" window. Then press <Enter> once to choose the filename and again to complete loading of the file. Clicking on the filename with the mouse is quickest. Note that the current filename is displayed in the upper right corner of the screen.

Save current file:
This option saves the current file and any edits without exiting the program.

Save file, New name:
This option activates the dialog box "Save Data File As" and is used to save a copy of a data file under a different name. There will then be two copies of the data file under two different filenames.

Exit:
This option produces a warning screen that provides the choice to save & exit or to exit the IHAFF SUITE program without saving.

PATIENT INFORMATION OPTION (MAIN MENU)

This activates the dialog box to enter demographic information about the individual patient. Note that the "Date" entry requires 2-number entries per part (04/03/94). Slashes are automatically inserted.

CONTOUR, VIOLA, and APHAB OPTIONS (MAIN MENU)

Each choice accesses a separate menu for each of these program functions. If you cannot administer Contour under computer control, you will need to use a manual method. In this case, "None attached" should have been selected as the audiometer type in "Audiometer Setup" and then you will go directly to the VIOLA Configure screen and manually enter the median response levels you obtained.

SETUP OPTION (MAIN MENU)

This Main Menu option is used to configure the program for
hardware and software choices appropriate to your needs.

**Printer Setup:**
Use <Tab> and arrow keys to highlight the choices for the printer setup. Regarding "Resolution", note that low resolution prints faster; high resolution prints slowest but the graphics are smoother and more accurate.

**Audiometer Setup:**
This is used to choose the audiometer you will use when running the Contour test under computer control. The radio button "None attached" should be selected if your audiometer is not included among the options or if it does not have a serial RS232 port interfaced with the computer. The Contour test would then have to be administered manually. With this radio button selected, you can run a simulation of the Contour test and you are also able to edit data in VIOLA.

**Program Directories:**
Each field should contain the complete directory path where the program will store data files and files needed to run the program. Refer to information under the heading "SYSTEM REQUIREMENTS" regarding the creation of subdirectories. The default directory for all three fields on this screen is the one on which the program was installed. The "Data Directory" can be some other directory, such as one created to be separate from the program files and dedicated only to storing patient data (C:\IHAFF\PATIENTS was suggested in SYSTEM REQUIREMENTS). The "Backup Directory" currently is not being used. The "BGI Directory" can be a separate directory where graphics files (.BGI, etc.) can be stored and used for several programs rather than have copies of the same graphics files in multiple directories. If you are not using a separate BGI directory, the directory path in this field should be the program directory (C:\IHAFF was suggested in SYSTEM REQUIREMENTS). Just be sure that the paths and subdirectory names are the same as those you created or the program will not be able to find files that it needs. Also, be sure to edit this information if ever the paths or subdirectory names are changed.
CONTOUR MENU

STIMULUS

Since the audiometer setup and data directory setup are done from the Main Menu, the test stimulus parameters are the only things left to configure. This selection opens a dialog box used for this purpose. Use the mouse or <Tab> to move through the "THR" and "CORR" entry fields. In this screen, the cursor keys will only work in the "THR units" field. The stimulus used for the Contour test is a 4-pulse presentation of warble tones. Note that data in CORR and THR must be entered in whole numbers.

THR: enter patient's thresholds at each frequency being tested. The program adds an incremental increase to this level to provide a starting point to present an audible level of the stimulus.

Audiometer Correction (CORR): the information entered here is used by the program to set up the audiometer to present the stimulus at the appropriate level. Note that the correction value entered should equal the dB SPL(HA-1) value minus the dial level setting. For example: with a dial setting of 70 dB HL at 250 Hz, the signal level is measured on a sound level meter to be 85.6 dB SPL. You would enter your correction factor here as 16 (remember that the data must be in whole numbers!). If you are simply using the calibration values provided with the ER-3A earphones, your HA-1 coupler value at 250 Hz is 85.5, so you would enter your correction factor of 16 into the IHAFF program.

Resp. Time (ms): this is the response time interval, in milliseconds, allowed for the patient to respond following the 4-pulse stimulus presentation until the next stimulus presentation occurs. Failure to enter a response during this interval results in the program declaring a "no response" and repeating the presentation.

THR units: select whether thresholds entered in "THR" were in dB SPL or dB HL. Note that dB SPL assumes the use of ER-3A earphones calibrated in an HA-1 coupler. Thresholds entered in dB HL will be converted to dB SPL when they are used by the program.

Save as Default: this selection would save the entries on this screen to a default configuration file called CONSTIM.CFG. Since "CORR" and "THR units" values would rarely change, only thresholds would require editing for each additional patient.

TEST

This option produces a screen used to administer the Contour test. Movement in this screen is different from the other screens. To select a frequency to test, use the cursor keys to highlight the
selection, then press <Enter>. To switch between left and right ears, press <PgDn>.

!!!WARNING!!! The program will crash if you use the talkover/talk-forward while the audiometer is under computer control while in the Test screen. If you need to use talkover to communicate with the patient, press <Esc> to exit the Test screen and return to the Contour Menu.

A complete test of a frequency consists of three runs. The program runs the testing continuously until three complete runs are accomplished. The examiner types the patient's response (1-7) within the response interval. Each run ends when a response of "7" (uncomfortably loud) is entered. When a loudness test is in progress, press <A> at any time to abort the run. The most frequent reason to abort a run, other than the patient requesting to end the sequence, is a string of "no responses" at the beginning of the testing at a frequency. This occurs when the stimulus starting level is below the patient's actual threshold. You would need to go back to the "Stimulus" menu option and change the threshold to get a higher starting level.

!!WARNING!! Aborting before completion of the three runs at a frequency will abort/dump any data collected at that frequency for that ear!!

If a run reaches the maximum output level of the audiometer without a category 7 response, testing is paused and a message screen appears informing you of this and giving you a choice to abort or continue testing. This situation is likely with a patient whose hearing loss is so great at a frequency that the stimulus level is never judged to be "uncomfortably loud". If you select "abort", the data you have collected will be lost. Therefore, in this circumstance, it is advisable to choose "continue" and then the program will keep the data collected and continue with the next run. If for some reason you feel the data collected may be inaccurate (the patient responses may be very unexpected or unlikely), then selecting "abort" deletes this collected data and you could retest.

PRINT:

A table of the test results is immediately printed when this is selected. At the top of the printout are the name of the program function (CONTOUR), the current date, the patient's name, and the filename of the data file. There is a separate table for each ear.
At each frequency, the range of the levels of the responses and the median response level are recorded for each loudness category. A blank cell indicates that there were no responses for that category number.

**GRAPH**

This option displays a graph of the loudness contours for the seven loudness categories and the thresholds across frequency. Press <PgDn> to toggle between ears. Currently the graph cannot be printed with this program. See information on screen dump software at the beginning of this document.

**MAIN MENU**

This option returns the user to the Main Menu.

**VIOLA MENU**

*(Visual Input/Output Locator Algorithm)*

The VIOLA program requires no special configuration other than patient-specific input: the selection of the two frequencies to be graphed for each ear and the type of hearing aid to be used.

**CONFIGURE**

**Frequencies:**

The Configuration screen shows the median response levels for the loudness categories obtained using the Contour test. The program reads these values directly from the Contour test data. VIOLA has some ability to interpolate if no data is available for some categories. Note that you must choose two frequencies for each ear to be graphed in VIOLA in order to properly exit this screen, but make sure you choose ONLY two frequencies for each ear. Use the mouse or cursor keys to move to the desired frequency and press the spacebar to toggle the selection on/off. <Tab> moves you from the left ear to the right ear.

Remember that you can edit data only if "None attached" was selected in the Audiometer Setup. If this was done, pressing <Tab> further, moves you from the right ear field and on through the loudness category fields, where you are able to manually enter the median response levels obtained from a manual administration of the Contour test. <Shift>+<Tab> moves you in the reverse direction. If for some reason you were not pleased with the Contour data, you may edit the data by going to the Audiometer Setup Option in the Main Menu and changing the selec-
tion to "None Attached", then return to the VIOLA/CONFIGURE/
Frequencies menu option and edit the data. !WARNING!! There
is an interaction between the Contour data and the VIOLA data!!
Editing the median levels in VIOLA which were read directly
from Contour data, causes the program simultaneously to over-
write the old median levels in Contour, as well as the range.
Therefore, it is not advisable to use VIOLA to edit Contour
data unless the data was collected manually.

When entering this data in this VIOLA, the screen has a notation
about what type of data (dB HL or dB SPL) the program expects.
This is based on what was chosen in the CONTOUR/STIMULUS config-
uration. The program will change the data to dB SPL, if neces-
sary, when generating the Input/Output graphs.

Hearing Aid Type:
Select an appropriate hearing aid type for each ear. Selection of
the Speech Level determines the values used for the level of soft,
average, and loud speech, which will be graphed as vertical dotted
lines on the graph described below.

GRAPH

This option produces a screen which contains a table at the top for
entering hearing aid parameters. These parameters interact with the
graph at the bottom of the screen.

The screen graphs show the patient's soft, comfortable, and loud
perception ranges in horizontal shaded bands. The input levels for
soft, average, and loud speech are indicated by vertical dotted
lines. An asterisk along each of these vertical lines marks the
target value for each speech input level. The diagonal dashed line
depicts zero gain. Therefore, the difference between this diagonal
line and the target value gives the target gain for that speech
input level at the frequency graphed.

In the table at the top of the screen, enter parameters for up to
three hearing aid setting configurations at the two previously-
chosen frequencies (see Configure/Frequencies). <Tab> moves you
between parameter columns, while cursor keys move you within the
columns, or you can use the mouse. <PgDn> toggles between left and
right ear's graph display. Use <delete> to edit values in a
parameter cell. When you edit parameters already graphed, pressing
<F9> redraws the displayed graph. <Esc> exits the screen graph.
YOU MUST ENTER WHOLE NUMBERS FOR COMPRESSION RATIO. For example,
for a compression ratio of 4:1, you must enter "4".
PRINT

For each ear, select the lines that you wish to be printed. "Line 1", etc. refers to the hearing aid configuration columns in the table at the top of the screen graph. There will be a separate graph printed for each ear and for each selected "line". At the top of the printout are the program function (VIOLA), the current date, the patient's name, the data filename, the ear for this printout, the hearing aid type, and a table of the hearing aid configuration parameters. At the bottom of the printout is the graph for this configuration as it appears in the screen graph.

MAIN MENU

This option returns the user to the Main Menu.

APHAB
(Abbreviated Profile of Hearing Aid Benefit)

QUESTIONNAIRE

Patient Information:
Enter the patient's name and specify the questionnaire form (A or B). Two blank lines are provided for optional comments. If the patient is a hearing aid user, enter the appropriate choice for hearing aid experience, daily hearing aid use, and age. The "Columns to Edit" field is used to select which parts of the APHAB will be used. You can choose aided only, unaided only, or both conditions.

Clinician (Edit):
Selecting the "Clinician (Edit)" option allows the clinician to record patient's answers. This would be used either in a situation in which patients are unable to record their answers or in which a printed questionnaire has been completed by the patient and the program is used to score the responses. Enter "N" for any un-answered questions. Press <Esc> when responses to all questions have been entered.

Patient (Edit):
Selecting the "Patient (Edit)" option allows the patient to complete the questionnaire directly on the computer. Use the up/down arrow keys to highlight the chosen response, then press <Enter> to record the choice. If both columns were selected for editing under "Patient Information", the left/right arrow keys allow the patient to move between the with/without hearing aid columns. <PgDn> moves to the next question and <PgUp> moves to
the previous question.

If the "Patient Edit" option is to be chosen so that the patient completes the APHAB directly on the computer, it is possible for the clinician to "lock" the program so that the patient cannot accidently change other parts of the program. To lock the program, press <Ctrl>+F5 anytime you are at the APHAB main menu. An asterisk will appear at the top left of the screen to show that the program is locked. When the asterisk is visible, all options except "Patient Edit" are greyed out and cannot be accessed. To unlock the program, return to the APHAB main menu and press <Ctrl>+F5 again.

OPTIONS

Graph data:
Selecting this option lets you display the graphed results to the screen. Three screens, unaided only, aided only, or benefit (unaided minus aided), are displayed in rotation by pressing any key. Screens for unaided only or aided only display:
(a) A graph of subscale scores (frequency of problems) compared with the 20th and 80th percentile profiles of successful linear hearing aid wearers.
(b) A display of the responses to each of the 24 items. This should be checked to make sure that the patient did not simply select the same response every time, or respond in some other anomalous manner.
(c) A pie chart showing the number of times each different response was selected. Usually a patient will select a variety of responses.
The screen for "Benefit" displays a graph of subscale scores (aided and unaided) for frequency of problems, a table of the aided, unaided, and benefit subscale scores, and a graph of the benefit scores for the four subscales compared with equal-percentile profiles from successful wearers of linear hearing aids.

The "Graph Data" options cannot be printed by this program but a hard copy can be obtained through the use of an appropriate screen dump program such as referred to at the beginning of this document.

Print:
Selecting "Print" enables the user to print the contents of the current data file. The resulting printout shows patient information and subscale scores as well as graphs displaying:
(a) the response pattern for the 24 items for each response mode that has been completed
(b) aided, unaided, and benefit scores compared with equal-percentile profiles obtained from successful linear hearing aid wearers
The pie chart displayed to the screen is not included on the printout.

**MAIN MENU**

This option returns the user to the Main Menu.

>PLEASE NOTE THAT YOU NEED TO SAVE YOUR DATA FILES AS YOU EDIT THEM. THERE IS NO AUTOSAVE FUNCTION BUILT INTO THIS PROGRAM !!! You must go to the Main Menu and select "Save current file" under the FILE option on the Main Menu.

**DATA REPORTING:**

In an effort to standardize the format in which data from fittings using the IHAFF protocol are reported, we have developed a data checklist and report form. Please use this form in reporting your findings.

In addition to the instructions provided in the syllabus that accompanied your software, please observe the following:

**I. LOUDNESS JUDGEMENT TESTING**

When performing loudness judgement testing, have the patient read the instructions, and go over them to make sure they are understood. Additional points to offer verbally should include:

- More than one level of loudness may be judged at a given level. For example, several tones of differing loudness may be judged as "3".
- Assure the patient that every loudness level does not necessarily need to be used in order; it is acceptable to skip a level.

Whether using a manual or computer driven procedure, a practice run is essential. The contour software does not automatically employ a practice run. To perform a practice run, start an automatic test and abort after a single run up to 7. When considering test results, use good clinical judgement while inspecting the range of responses. If particularly wide ranges are noted at a given frequency when compared to others, consider repeating the frequency.

**II. VIOLA**

The most useful technique in entering "trial aid" data is to use parameters that are known to exist in aids that you are familiar with. If the parameters of a known instrument offer a good "match" with the VIOLA targets, it saves hours of searching through endless spec. books for the ideal instrument. It will be useful to run some investigational I/O curves at different frequencies for some representative hearing aids with output limiting, input compression,
wide dynamic range compression, etc. to set up your own facility "matrix book".

III. APHAB

For the purpose of standardized data collection, the following procedures for administration of the APHAB are recommended.

- The "unaided" section of the APHAB should be given before the hearing aid is fitted.
- If possible, review the instructions and test items with the patient, offering alternate similar situations if they have not, or do not experience situations as noted in the test. If they cannot relate to a situation, leave the item blank.
- The aided portion of the APHAB should be completed after a minimum of two, or better yet, three weeks of hearing aid use. When performing the aided portion of the test, allow the patient to see how they responded in the unaided section.

Please return the completed data reporting forms to:
Gerald Schuchman, Ph.D.
VAMC - 126
Audiology and Speech Pathology
50 Irving St. NW
Washington, DC 20422

(202) 745-8270
FAX (202) 745-8579
IHAF PROTOCOL
FITTING CHECKLIST AND DATA REPORTING FORM

REPORT DATE:__________

FIELD SITE/CLINIC:________________________________________

PATIENT/CLIENT ID:________________________________________
Age:_________ Sex:_____

HEARING AID USE HISTORY:
New user:____ Previous user:_____
Monaural:____ Binaural:____ How long:_____

LOUDNESS JUDGEMENTS:
Manual worksheets attached____ OR
Contour printout attached ______

VIOLA printout with selected parametrs attached_____
Subtract 5dB Gain for binaural_______ Reserve gain added_____
Unaided APHAB completed before fitting_____

VERIFICATION & FITTING
Copies of Electroacoustic analysis I/O curves @ VIOLA frequencies____
ANSI S3.22 test sequence attached_____
2cc SSPL90 levels do not reach coupler equivalent of 7 rating_____
Distortion levels within spec's and less than 10% @ 90 dBSPL input_____
65dBSPL speech is rated at 3, 4, OR 5____(circle)

AIDED SOUNDFIELD THRESHOLDS:

<table>
<thead>
<tr>
<th>Hz.</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBHL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Behavioral thresholds_______ *Derived from probe_____
*(See notes page 12 of syllabus. B.Aided measures: 2. Low level sounds)

85 dBSPL speech rated at a level of 6_____
REAR observed for bandwidth and smoothness (attach)_____
RESR @ 90 dBSPL tone sweep: Observe, ensure #7 not reached_____
Real-life sounds check: ensure #7 not reached_____

TWO TO FOUR WEEK FOLLOW-UP
Aids used _____ hours per day?
• If not worn due to physical discomfort, adjust/modify for improvement and extend evalution period.
• If not worn due to electroacoustic complaints, aided APHAB may help with diagnosis of problem.
Aided APHAB after two weeks successful use (attach printouts)_____
Aid matrix and circuit compression characteristics if available:
Comments, changes from VIOLA recommendations:
<table>
<thead>
<tr>
<th>MARKWOOD</th>
<th>Left 1</th>
<th>Left 2</th>
<th>Left 3</th>
<th>Right 1</th>
<th>Right 2</th>
<th>Right 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain at 40 dB</td>
<td>1</td>
<td></td>
<td></td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp Threshold</td>
<td>820</td>
<td></td>
<td></td>
<td>820</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR begin</td>
<td>10</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR end</td>
<td>10</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Output</td>
<td>95</td>
<td></td>
<td></td>
<td>95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**500 Hz**

These displays demonstrate the hearing loss and loudness judgements for an individual with a mild hearing loss at 500 Hz., and a severe loss at 3K Hz. Note that the calculated "targets" (*) for the 500 Hz. band are at less than unity gain, so no gain was selected for 500 Hz., and a linear response up to a knee of 82 was selected for the 3000 Hz. band. The output compression hearing aid selected has a 10:1 compression ratio and is limited at 95 dB output.
ABBREVIATED PROFILE OF HEARING AID BENEFIT

NAME: _______________________________ TODAY’S DATE: ___/___/___ DATE OF BIRTH: ___/___/___

Last                      First

ADDRESS: ________________________________

TELEPHONE: (home) __________________ (work) __________________ SSN: __________________

HEARING AID EXPERIENCE: DAILY HEARING AID USE: EMPLOYMENT:

___ Less than 6 weeks ___ Less than 1 hour per day ___ Full-time
___ 6 weeks to 11 months ___ 1 to 4 hours per day ___ Part-time
___ 1 to 10 years ___ 4 to 8 hours per day ___ Not employed outside
___ Over 10 years ___ 8 to 16 hours per day the home, or retired

INSTRUCTIONS: Please circle the answers that come closest to your everyday experience. Notice that each choice includes a percentage. You can use this to help you decide on your answer. For example, if a statement is true about 75% of the time, circle "C" for that item. If you have not experienced the situation we describe, try to think of a similar situation that you have been in and respond for that situation. If you have no idea, leave that item blank.

Without My Hearing Aid          With My Hearing Aid

1. When I am in a crowded grocery store, talking with the cashier, I can follow the conversation. A B C D E F G A B C D E F G

2. I miss a lot of information when I'm listening to a lecture. A B C D E F G A B C D E F G

3. Unexpected sounds, like a smoke detector or alarm bell are uncomfortable. A B C D E F G A B C D E F G

4. I have difficulty hearing a conversation when I'm with one of my family at home. A B C D E F G A B C D E F G

5. I have trouble understanding dialogue in a movie or at the theater. A B C D E F G A B C D E F G

6. When I am listening to the news on the car radio, and family members are talking, I have trouble hearing the news. A B C D E F G A B C D E F G

7. When I am at the dinner table with several people, and am trying to have a conversation with one person, understanding speech is difficult. A B C D E F G A B C D E F G

8. Traffic noises are too loud. A B C D E F G A B C D E F G

9. When I am talking with someone across a large empty room, I understand the words. A B C D E F G A B C D E F G

10. When I am in a small office, interviewing or answering questions, I have difficulty following the conversation. A B C D E F G A B C D E F G

11. When I am in a theater watching a movie or play, and the people around me are whispering and rustling paper wrappers, I can still make out the dialogue. A B C D E F G A B C D E F G

12. When I am having a quiet conversation with a friend, I have difficulty understanding. A B C D E F G A B C D E F G

13. The sounds of running water, such as a toilet or shower, are uncomfortably loud. A B C D E F G A B C D E F G
14. When a speaker is addressing a small group, and everyone is listening quietly, I have to strain to understand ........................................... A B C D E F G A B C D E F G

15. When I'm in a quiet conversation with my doctor in an examination room, it is hard to follow the conversation ........................................... A B C D E F G A B C D E F G

16. I can understand conversations even when several people are talking .................................................................................................................. A B C D E F G A B C D E F G

17. The sounds of construction work are uncomfortably loud ........................................... A B C D E F G A B C D E F G

18. It's hard for me to understand what is being said at lectures or church services ........................................................................................................... A B C D E F G A B C D E F G

19. I can communicate with others when we are in a crowd ........................................... A B C D E F G A B C D E F G

20. The sound of a fire engine siren close by is so loud that I need to cover my ears ........................................................................................................... A B C D E F G A B C D E F G

21. I can follow the words of a sermon when listening to a religious service .................................................................................................................. A B C D E F G A B C D E F G

22. The sound of screeching tires is uncomfortably loud ........................................... A B C D E F G A B C D E F G

23. I have to ask people to repeat themselves in one-on-one conversation in a quiet room ........................................................................................................... A B C D E F G A B C D E F G

24. I have trouble understanding others when an air conditioner or fan is on .................................................................................................................. A B C D E F G A B C D E F G

FOR AUDIOLOGIST USE ONLY

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<th>HEARING AID TYPE:</th>
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<td>Make</td>
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<td>_____ Bilateral</td>
<td>_____ ITC</td>
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<td>_____ Compression</td>
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Comments:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

HARL
Hearing Aid Research Lab
NAME: ____________________________ TODAY'S DATE: __/__/___ DATE OF BIRTH: __/__/___

Last First

ADDRESS: __________________________________________________________

TELEPHONE: (home) __________________________ (work) __________________________ SSN: ________________

HEARING AID EXPERIENCE: ________________________ DAILY HEARING AID USE: ________________________ EMPLOYMENT: ________________________

☐ Less than 6 weeks ☐ Less than 1 hour per day ☐ Full-time

☐ 6 weeks to 11 months ☐ 1 to 4 hours per day ☐ Part-time

☐ 1 to 10 years ☐ 4 to 8 hours per day ☐ Not employed outside

☐ Over 10 years ☐ 8 to 16 hours per day ☐ the home, or retired

INSTRUCTIONS: Please circle the answers that come closest to your everyday experience. Notice that each choice includes a percentage. You can use this to help you decide on your answer. For example, if a statement is true about 75% of the time, circle "C" for that item. If you have not experienced the situation we describe, try to think of a similar situation that you have been in and respond for that situation. If you have no idea, leave that item blank.

1. The sound of a fire engine siren close by is so loud that I need to cover my ears.................................................................
   A   B   C   D   E   F   G
   Without My Hearing Aid   With My Hearing Aid

2. When a speaker is addressing a small group, and everyone is listening quietly, I have to strain to understand ............................
   A   B   C   D   E   F   G

3. It's hard for me to understand what is being said at lectures or church services .........................................................
   A   B   C   D   E   F   G

4. When I am at the dinner table with several people, and I am trying to have a conversation with one person, understanding speech is difficult.................................................................
   A   B   C   D   E   F   G

5. When I am in a theater watching a movie or play, and the people around me are whispering and rustling paper wrappers, I can still make out the dialogue..................................................
   A   B   C   D   E   F   G

6. When I'm in a quiet conversation with my doctor in an examination room, it is hard to follow the conversation.................
   A   B   C   D   E   F   G

7. When I am listening to the news on the car radio, and family members are talking, I have trouble hearing the news.............
   A   B   C   D   E   F   G

8. The sounds of running water, such as a toilet or shower, are uncomfortably loud ............................................................
   A   B   C   D   E   F   G

9. When I am having a quiet conversation with a friend, I have difficulty understanding......................................................
   A   B   C   D   E   F   G

10. I can understand conversations even when several people are talking ..............................................................................
    A   B   C   D   E   F   G

11. The sounds of construction work are uncomfortably loud..............
    A   B   C   D   E   F   G

12. I have trouble understanding others when an air conditioner or fan is on .................................................................
    A   B   C   D   E   F   G
13. I have trouble understanding dialogue in a movie or at the theater................................................................. Without My Hearing Aid  |  With My Hearing Aid
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14. Traffic noises are too loud......................................................... Without My Hearing Aid  |  With My Hearing Aid
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15. When I am in a small office, interviewing or answering questions, I have difficulty following the conversation................................................................. Without My Hearing Aid  |  With My Hearing Aid
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16. I miss a lot of information when I'm listening to a lecture................................. Without My Hearing Aid  |  With My Hearing Aid
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17. I have to ask people to repeat themselves in one-on-one conversation in a quiet room................................................................. Without My Hearing Aid  |  With My Hearing Aid
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18. Unexpected sounds, like a smoke detector or alarm bell are uncomfortable................................................................. Without My Hearing Aid  |  With My Hearing Aid
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</table>
19. I can follow the words of a sermon when listening to a religious service................................................................. Without My Hearing Aid  |  With My Hearing Aid
<table>
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<tr>
<th>A</th>
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</table>
20. When I am in a crowded grocery store, talking with the cashier, I can follow the conversation................................................................. Without My Hearing Aid  |  With My Hearing Aid
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</table>
21. I can communicate with others when we are in a crowd................................................................. Without My Hearing Aid  |  With My Hearing Aid
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</table>
23. I have difficulty hearing a conversation when I'm with one of my family at home................................................................. Without My Hearing Aid  |  With My Hearing Aid
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24. When I am talking with someone across a large empty room, I understand the words................................................................. Without My Hearing Aid  |  With My Hearing Aid
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FOR AUDIOLOGIST USE ONLY

HEARING AID FITTING: __ Unilateral, __ Bilateral, __ Directional Mic, __ Compression

HEARING AID TYPE: __ CIC, __ ITC, __ ITE, __ BTE

HEARING AID: Make __________________________ Model __________________________ Ser. # __________________________ Fitted __________________________

Comments: ____________________________________________________________

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HL to HA-1 SPL corrections: 250=+18, 600=+8, 1k=+4, 2k=+7, 3k=+6, 4k=+2.
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**Convert to HA-1 SPL**

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<table>
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<th>Mdn.</th>
<th>Corr.</th>
<th>HA-1</th>
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**HL to HA-1 SPL corrections:** 250=+16, 500=+8, 1k=+4, 2k=+7, 3k=+6, 4k=+2.
## Contour Test Worksheet - 2 dB Increments

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### Convert to HA-1 SPL

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<th>Corr.</th>
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<td>6(lok)</td>
<td>5(csl)</td>
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<tr>
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<td>Cat#</td>
<td>Mdn.</td>
<td>Corr.</td>
</tr>
<tr>
<td>HA-1</td>
<td>7(ucl)</td>
<td>6(lok)</td>
<td>5(csl)</td>
</tr>
</tbody>
</table>

### HL to HA-1 SPL corrections:

- 250 = +16
- 500 = +9
- 1k = +4
- 2k = +7
- 3k = +6
- 4k = +2

---

*Note: The table and conversion process is for demonstration purposes, and actual clinical data should follow established protocols and medical guidelines.*