

audifon

How Fit is "First Fit"?

The significance of pre-setting information

As technical support for audifon USA, much of my time is spent talking with hearing health care professionals as they begin using or initiate first fitting of an instrument in the audifit programming software. As you know, the first fitting of an instrument is the “spring board” from which subsequent adjustments are made and often sets the stage for the initial response of the patient to amplification.

When I receive a call for assistance with the software or with a patient fitting, I will routinely ask a series of questions before proceeding with the fitting assistance. First I will ask about the circuit choice. For audifon, this might be the elia, Prado, Switch or via CROS/BiCROS for example. I will ask for the model, custom, BTE or Receiver- In- The- Ear. If you are fitting a BTE, are you fitting a standard ear mold, thin tube or a RITE with or without a dome or Power Sleeve? I may even ask if you have made any special venting or tubing requests.

Beyond the circuit and model, I will ask for the patient’s audiologic test results including air/bone conduction thresholds and LDL (UCL) results.

All of this information serves two purposes. First, it allows me to simulate the instrument that is being fit so that I can match your settings. More importantly, each of these variables can have a significant effect on the accurateness of the first fit settings of the instrument.

First, consider the audiogram. Consistent with all manufacturers’ software, the audiologist must enter the patient’s pure tone thresholds for each patient before initiating the first fit programming. What I often hear from many professionals, however, and what Gus Mueller indicates in a recent AudiologyOnline article (Mueller, 2011), is that LDLs are often not completed during testing or that broadband speech loudness testing is completed rather than frequency specific LDL testing. Further, even if the testing is completed, the results are often not entered into the programming software.

These frequency specific LDL values are used by the programming software to appropriately set the MPO of the hearing instrument. The assumption that the software will always accurately calculate the MPO from the thresholds is erroneous (Mueller, 2009).

Consider the example in Figure 1.

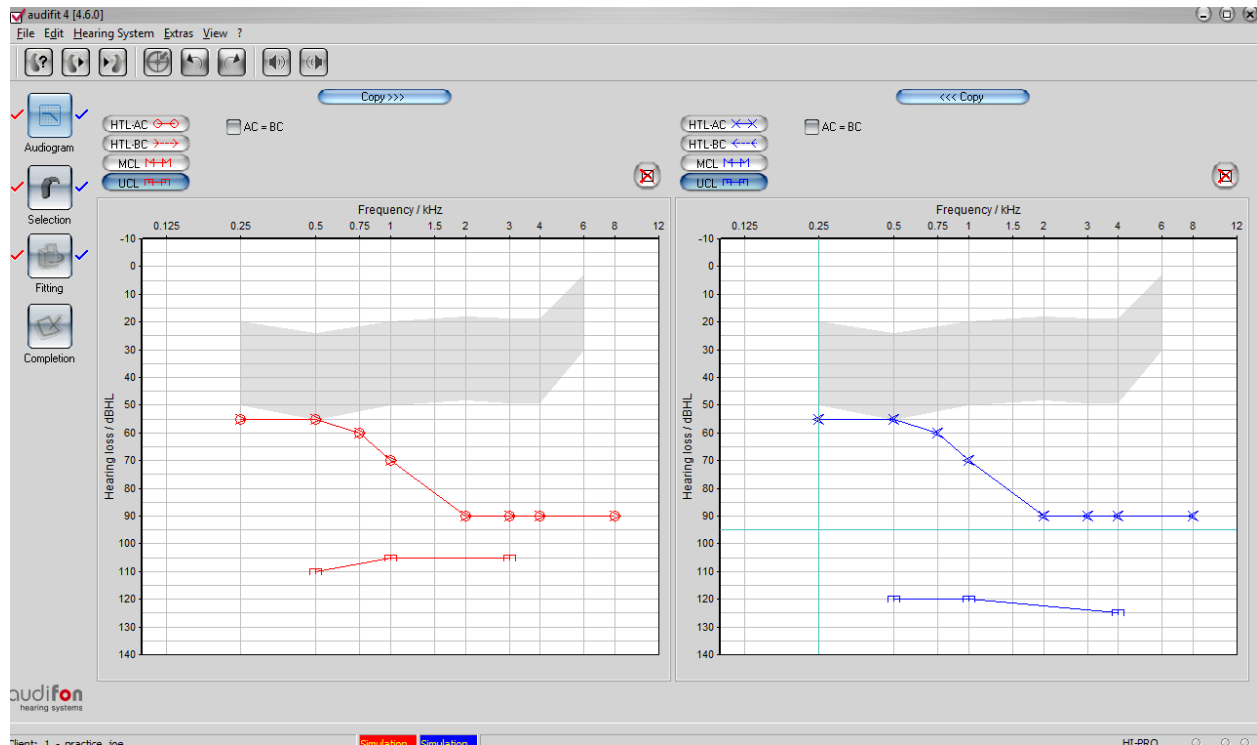


Figure 1. Symmetrical audiogram with frequency-specific LDL values.

In this scenario, the same instrument, in this case, an elia M BTE, has been simulated in the audifit programming software and fit to a bilateral moderate to severe sloping sensorineural hearing loss. The loss is symmetrical except for the LDL values at 500, 1000 and 3000 Hz. The right ear LDL reflects a narrow dynamic range in the 3000 Hz range with 15 dB difference between the threshold and LDL.

The left ear LDLs, at the same frequencies, reflects a 35 dB dynamic range. Figure 1.

No default settings were changed in the pre-setting page. These included Acclimatization Level 2, NAL-NL1 fitting formula, ear-hook coupled with earmold and <1mm vent and standard #13 tubing.

Following the first fit programming using consistent settings between the simulated instruments, the following settings were observed (Figure 2).

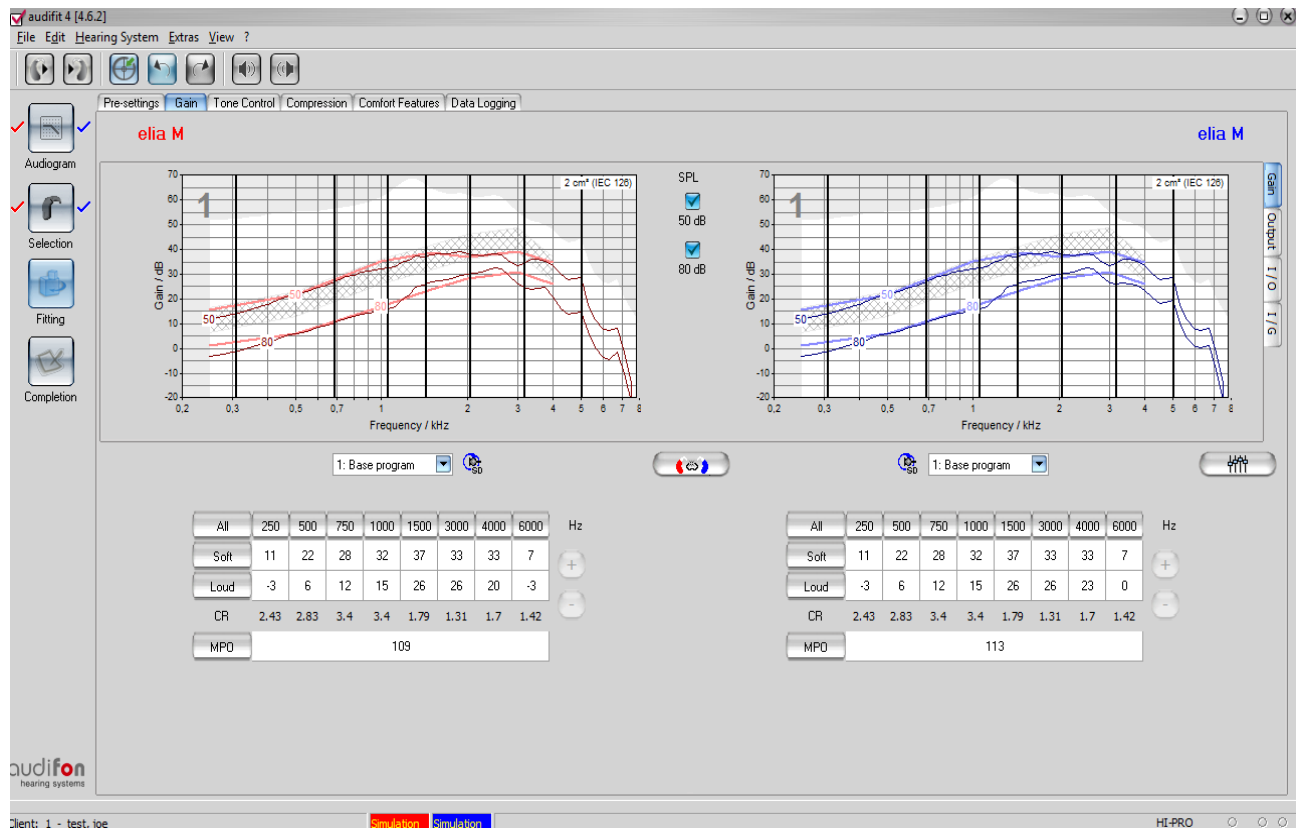


Figure 2. First fit settings based on audiogram shown in Figure 1.

Note that the gain is the same between settings reflecting the symmetrical thresholds. However, note the difference in maximum power output (MPO)

between the right instrument with the narrow dynamic range at 109 dB MPO and the left instrument for the ear with the wider dynamic range at 113 dB.

When the LDLs were omitted for the same fitting and all other settings remained the same, observe the increase of MPO to 113 for the right ear, shown in Figure 3.

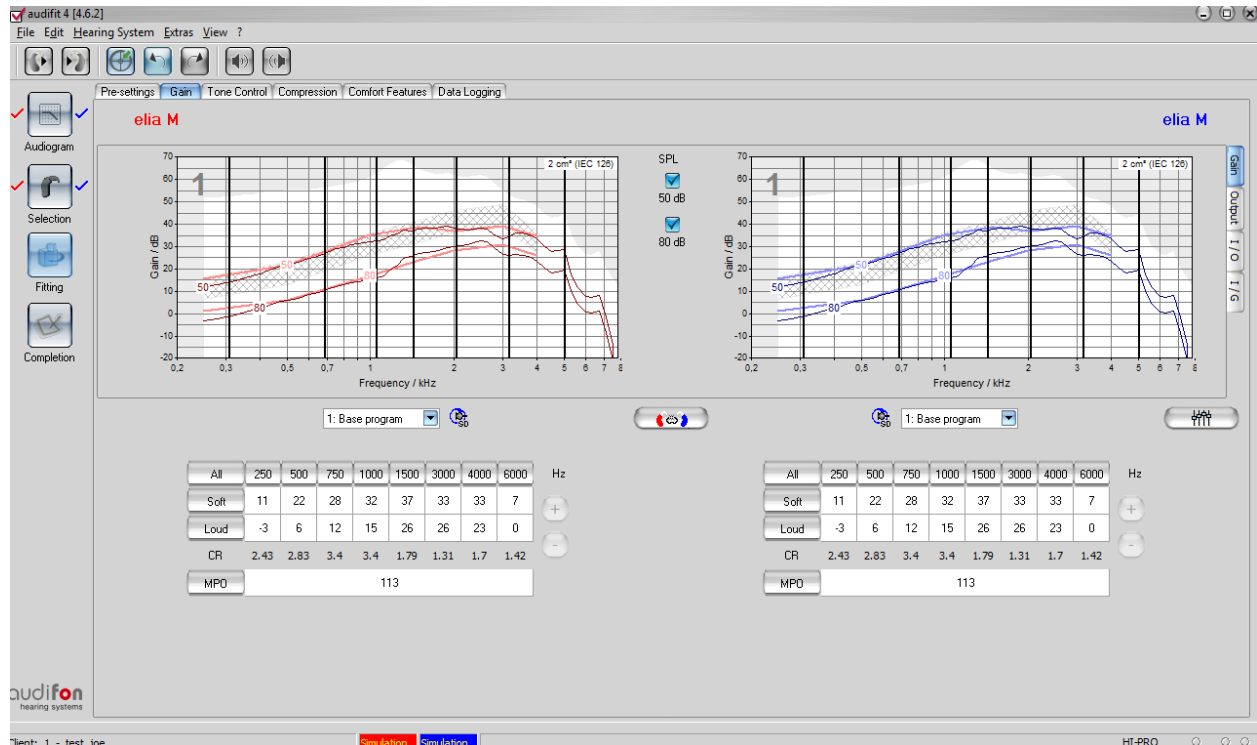


Figure 3. Effect of omitting LDLs on the calculated MPO values.

There are 3 issues that I would like to consider:

1. The importance of completing frequency specific LDLs during the audiometric evaluation.
2. The importance of including these values into the programming software during the pre-fitting settings to achieve more appropriate MPO settings and increased patient comfort.
3. The question of whether we should allow the fitting software to determine the MPO of the instrument based on the thresholds.

There are additional pre-setting parameters that should be considered that will affect the first fit of an instrument.

- Acclimatization Level
- Fitting formula
- Acoustical Parameters: coupling method, tubing and venting

Fitting software will take each of these into consideration when completing the first fit. The software will also make certain default assumptions about the instrument that is connected.



Figure 4. Pre-setting defaults.

Following are comparisons of the effect of the changing acclimatization levels (Table 1), fitting formula and coupling method (Table 2) along with some general summary statements about the results for your consideration. Keep in mind that this comparison is based on a single fitting scenario and intended only to highlight expected trends for how various changes in parameters may affect first fit settings.

Acclimatization Comparison								
Level	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	3000 Hz	4000 Hz	6000 Hz
1	9 dB	20	26	29	33	28	29	6
2	11 dB	22	28	32	37	33	33	7
3	11 dB	24	32	35	41	37	37	11

Table 1. Comparisons of changing acclimatization levels. All other parameters remain unchanged.

- A 2-4 dB difference in gain between levels with less increase between levels in the low frequencies
- Up to 9 dB difference in gain between levels 1 and 3 occurring primarily above 1000 Hz
- Consider this increase in gain between levels especially when fitting thin tube open instruments or RITEs. Remember that increased gain increases risk of feedback but also that AFC², audifon's feedback cancellation, allows up to 10 dB of additional gain before feedback.
- There was no apparent change in the compression ratio or the output of the instrument with change in acclimatization level



Figure 5. Acoustical parameters for coupling method and fitting formula.

Acoustical Parameters										
Earhook with earmold vs. open fitting										
Gain for soft sounds as a function of fitting formula										
Rule	250	500	750	1000	1500	3000	4000	6000	CR	MPO
Nal-NL1	11/- 11	22/ 8	28/ 22	32/ 29	37/ 35	33/ 30	33/ 22	7/ 6	Av. 2.38/ 2.41	(R)109/ (L) 113 closed 106/106 open
Pogo	10/- 11	17/ 1	23/ 11	25/ 23	32/ 33	36/ 37	31/ 32	7/ 16	1:1	121/ 108
Nal-R	6/- 16	17/ 1	23/ 14	26/ 24	33/ 31	35/ 31	39/ 26	13/ 10	1:1	114/ 108
½ gain	12/- 4	19/ 6	25/15	27/ 24	36/ 33	39/ 37	39/ 32	13/ 16	1:1	121/ 108

Table 2. Comparison of ear hook with mold (values in black) with open fitting (values in red) on gain for soft sounds as a function of fitting formula.

When changing the acoustical parameters from earhook with earmold to open thin tube fitting:

- The gain was significantly reduced for open fitting between 250 Hz to 500 Hz with less reduction for the open fit above 1000 Hz to maintaining gain for audibility. (If you don't indicate in the software that you changed from earhook with earmold to a thin tube, it will assume that you have not changed.
- The compression ratio averaged from 2.3 with a closed fitting and slightly higher at 2.41 for open fitting (NAL-NL1) using higher compression ratios to decrease the gain.
- The output decreased significantly with open fittings.

As a function of fitting formula:

- All formulas significantly decreased gain and output with open fitting configuration.
- NAL-R output level was lower than other formulas with less reduction between the two fitting configurations
- Gain reduction for all formulas was most aggressive in the 250-500 Hz range, while preserving relative gain above 750 Hz. ***The amount of gain reduction in the low frequencies would of course be dependent on the hearing loss configuration and amount of initial gain.**
- Note the difference in the amount of gain applied above 4000 Hz. Gain at 6000 Hz was minimal with little change between open and closed fittings.
- Other formulas* compared to NAL-NL1 at 6000 Hz:
 - **Pogo**: gain equal to NAL-NL1 for closed fitting but 9 dB greater for open fitting.
 - **NAL-R**: 6 dB more gain for closed fitting and slightly lower gain for open fit.
 - **½ gain**: Same gain for closed fitting as NAL-R and increased gain for open fitting***Other formulas available in software were not included**
- NAL-NL1 utilizes compression actively while other formulas function linearly with a 1:1 compression ratio.

Summary

The focus of the of this discussion and comparisons of first fit pre-setting parameters is not intended to offer specifics regarding data or the expected levels of gain for a particular fitting. It is also understood that first fit algorithms and outcomes will differ between manufacturers. The purpose here is to identify the importance of considering each pre-setting variable and the general effect that each will have on the first fit settings.

The information that we enter into the programming software and the pre-setting selections i.e. Acclimatization Level, Acoustic Parameters and Fitting Formula, will independently and collectively shape the first fit. Even a physical change in the vent (from the default <1mm to 3mm to open) or tubing change (from standard #13 to a 4mm Libby tubing) can alter the effectiveness of the first fit if that change is not indicated in the pre-setting parameters of the programming software.

Your programming software will apply specific default settings to all fittings and the only way that the software will know that you require to deviate from these settings is if you tell it, by entering the appropriate selections. Therefore, if you require more linear gain or more or less gain above 4000 Hz then the default fitting formula or the acclimatization level may not be appropriate. If you have changed the coupling method from a RITE open to a Power Sleeve or placed a large vent in your earmold then the pre-setting parameters should be changed to reflect this change. If your patient has a tolerance issue at 3000 Hz, omission of frequency specific LDLs or inclusion of a speech LDL may not trigger the software to select a lower MPO value in that frequency region.

The bottom line is that the specifics about your fitting that deviate from the defaults are what make the fitting individualized to your patient. There are many options and combinations of options available in fitting software. Your first fit is only as good as the information that you provide about the actual instrument, the test results and the pre-setting selections that you make.

Finally, it is important to note that the first fit is only the first step in achieving an accurate fitting. Best practice protocols for the adjustment and verification of amplification are equally essential to a successful final fitting and a successful outcome.

For more information about fitting, programming, and verifying audifon's hearing instruments, please contact me at eunice.straw@audifon-usa.com or at (800)-776-0222.

References

Mueller, H.G. (2011). How loud is too loud? Using loudness discomfort level measurements for hearing aid fitting and verification, Part1. *AudiologyOnline*, Article #2370. Direct URL:

http://www.audiologyonline.com/articles/article_detail.asp?article_id=2370