

FIG6 in Ten

By Toni C. Gitles, MA, and Patty Tillman Niquette, MA

Ten questions and their answers are provided about using average loudness data for pre-fitting wide-dynamic-range compression hearing aids such as those using the K-AMP® circuit:

1. What is FIG6?

FIG6 is a computer-based approach to fitting non-linear hearing aids that have wide dynamic range compression (WDRC), such as, but not restricted to, those with K-AMP® processing. Until recently, hearing aid fitting targets were for use only with linear hearing aids, with a single target curve for a single input level.

2. How does FIG6 work?

When entering the patient's audiometric thresholds, the program automatically calculates the fitting curves for low-level sounds (40 dB SPL), moderate level sounds (65 dB SPL), and high level sounds (95 dB SPL). Thus, FIG6 provides three gain and frequency response targets, one for each of three input levels. FIG6 calculates insertion gain targets (REIG) and 2 cc coupler response targets.

3. Why are there three target gain curves?

The available loudness growth data indicate that individuals with sensorineural hearing loss typically need less gain for intense sounds than for weak sounds. A single target gain curve, therefore, represents a compromise between adequate gain for weak sounds and too much gain for loud sounds. Such a compromise was required with linear hearing aids, which lacked the ability to modify their gain and response with level. We now have non-linear hearing aids that change their gain as a function of input level, so a single target makes little sense. More than three would even confuse Mead Killion.

4. Why were 40, 65 and 95 dB chosen?

An input level of 40 dB SPL represents the weaker elements of conversational speech. FIG6 estimates the gain required to provide aided sound field thresholds of 20 dB HL. (That goal is relaxed for hearing losses above 60 dB HL). A level of 65 dB SPL (50 dB HL) represents conversational speech. A level of 95 dB SPL represents normally loud speech and music. Dennis Van Vliet regularly and effortlessly hits 95 dB and Harvey Dillon's 9-month-old son can produce a 104 dB screech. Hearing aid dispensers converse at 95+ dB levels at national conventions, where the dance bands produce levels of 95-105 dB SPL.



Toni C. Gitles, MA, is director of education at Etymotic Research, Elk Grove Village, IL. Patty Tillman Niquette, MA, is an audiologist and hearing care consultant.

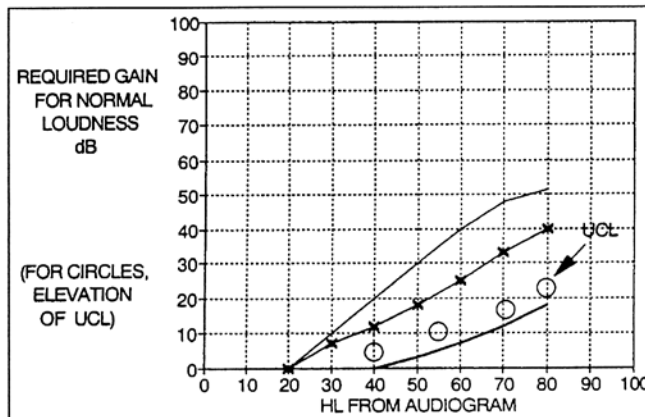


Fig. 1. Original "FIG6" diagram. Gain required to restore loudness for low-level (—), comfortable-level (X—X), and high-level (—●—) sounds. UCL data (O) from Pascoe® indicate that the required high-level gain is safe. Reprinted with permission from *The Hearing Journal*, Vol. 46, No. 11 (Killion & Fikret-Pasa').

5. Why is it called FIG6?

The name came from Fig. 6 in the article "Three Types of Sensorineural Hearing Loss."¹ The method of calculating gain and frequency response is based on the gain estimates shown in Fig. 6 of that article.

6. What principles does FIG6 use?

It is based on average loudness data that relates equal-loudness and threshold curves. Other loudness based approaches, such as the IHAFF approach, use the loudness data of individual patients. FIG6 is based on data from several published studies.

7. What are the published studies?

The data of Lippman², Lyregaard³, Hellman and Meiselman⁴, and Hellman⁵ provide information on how a person with sensorineural hearing loss perceives loudness compared to a person with normal hearing. In addition, Pascoe⁶ studied the MCLs and UCLs of 508 ears. Pascoe's MCL data are used to estimate the gain required to restore conversational level speech to the patient's MCL (the 65 dB curve). Mathematical formulas created from these data were used to calculate the level-dependent gain and frequency response appropriate to non-linear hearing aids.

8. Shouldn't individual loudness contour tests be performed?

Ideally, loudness tests should be performed for each hearing aid wearer, but it is not always possible or practical to do so. In most cases, targets based on average loudness growth data provide good first approximations. Individuals with more difficult-to-fit hearing losses, or those for whom amplification has been unsuccessful in the past, may require individual loudness tests.

9. Does the degree of hearing loss make any difference?

Yes. Individuals with a hearing loss between 20 and 70 dB HL are normally best served with WDRC hearing instruments. WDRC hearing instruments have also been successful for individuals with more severe hearing loss and reduced intelligibility scores, although an argument can be made that such individuals might be better served with variable recov-

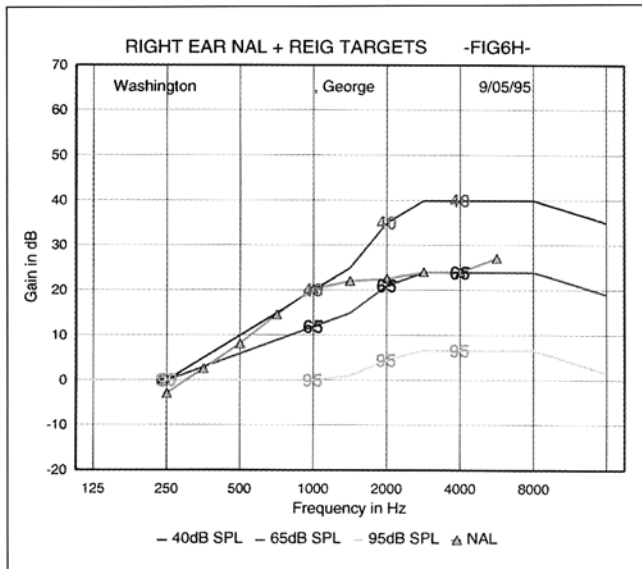


Fig. 2. FIG6 target gain curves for WDRC hearing aids with level-dependent frequency response. The target curves (and the NAL-R curve) correspond to the audiogram at the top of Fig. 3.

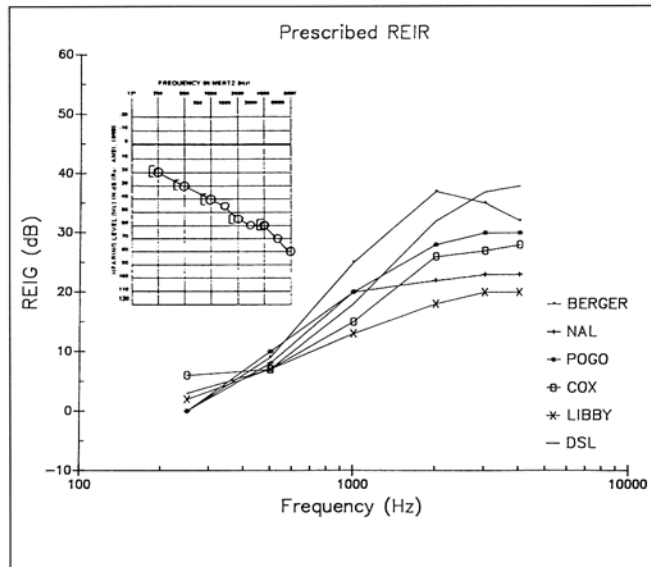


Fig. 3. Target gain for fixed-gain, fixed frequency-response hearing aids according to several popular formulae. Reprinted with permission from Singular Publishing (Hawkins, Mueller and Northern⁸).

ery time compression *limiting* instruments (see the arguments in "The Three Types of Sensorineural Hearing Loss"¹).

10. Can the dispenser utilize FIG6 to select the proper hearing aid matrix?

Yes. FIG6 calculates 2 cc coupler targets for BTE, ITE, ITC and CIC hearing instruments. The dispenser uses this information in combination with the manufacturer's published matrices to select the desired hearing aid matrix. *Note:* The appropriate CORFIG curves have been added to the 2 cc coupler curves, so a probe measurement of REIG on a client wearing an ITE, for example, ordered to match the ITE targets should, on the average, match the insertion gain target curves.

More than you may want to know about CORFIG curves is available. The Killion and Revit⁷ diffuse field CORFIG corrections themselves can be easily viewed; enter all zeros in the audiogram and select the corresponding 2 cc coupler curve on the pull-down menu. ♦

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The FIG6 software is available by contacting Toni Gitles at Etymotic Research, 61 Martin Lane, Elk Grove Village, IL 60007; telephone: (708) 228-0006.