



Programming Algorithms for Optimal Telecoil Settings

Patrick J. Murphy

Victor H. Bray, Jr.

Michael J. Nilsson

Chandler T. McDowel

ABSTRACT

The benefits of adopting a microphone-to-telecoil transfer function will be discussed. This transfer function establishes similar output levels between the two transducers at a given input level, thus ensuring that the microphone and telecoil are equivalent in loudness and sound quality. This paper will demonstrate how a transfer function has been implemented in programming software to facilitate the programming of telecoils for any hearing loss.

INTRODUCTION

It is well known that hearing-aid programs optimized for acoustic listening are not always adequate for telephone use with an inductive magnetic coil. Frequently, end users report that their devices are not loud enough and that clarity is usually poor on the telephone. This problem has often been addressed by increasing the low and middle frequencies to compensate for the weaker sensitivity of the telecoil at these frequencies. On the surface this solution is certainly helpful, but the hearing care professional is often left with the burden of “guessing” how much programming change is required to satisfy the needs of the user. Ideally, it is desirable to independently program the telecoil fitting to match the overall loudness and clarity of the acoustic program. To achieve this, it is necessary to establish common input levels for the microphone and telecoil to realize equal outputs. The Nordic Standard (EN 60118-1:1995) describes such a relationship and provides performance guidelines for a dedicated telecoil program that is perceptually similar to the one for the microphone.

THE NORDIC STANDARD

The Nordic Standard, as applied to telecoils, requires that “an inductive input signal of 31.6 mA/m shall give the same output signal level as an acoustical input signal (using the M-position) of 57–67 dB SPL in the frequency range of 1000–4000 Hz and of 55–67 dB SPL in the range of 500 up to 1000 Hz. This requirement applies for both T and MT positions and for any setting of the tone controls of the hearing aid” (EN 60118-1:1995, p. 14).

This standard has been implemented in the SONIC innovations EXPRESSfit™ programming software and allows for a telecoil fitting that is similar to the acoustic program in terms of perceived volume and sound quality. The 31.6 mA/m inductive field requirement should approximate the magnetic field produced by the “average” telephone. Although not required, the above standard has also been modified for “high-” and “low-” gain telecoil settings to accommodate weaker or stronger magnetic fields such as those encountered with telephones or room loop systems. It is expected that in a weak magnetic field (10 mA/m), a high-gain telecoil filter will allow the device to perform equivalently to the microphone program. In a moderate strength field (31.6 mA/m), the normal-gain telecoil filter should yield optimal performance. In a strong field (100 mA/m), the low-gain filter should be most appropriate.

METHODS

To demonstrate the implementation of the Nordic Standard with the transfer function just described, a SONIC innovations NATURA™ digital ITE device with a telecoil was programmed to produce 10 dB of gain at both the 50 and 90 dB SPL input

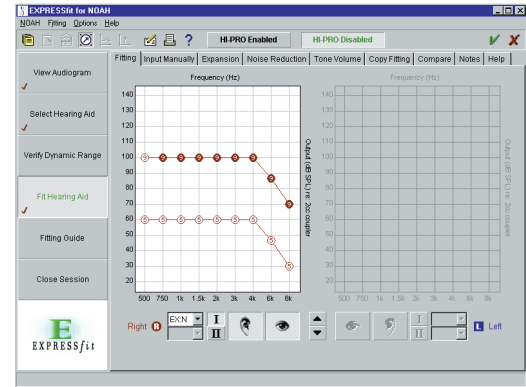


Figure 1

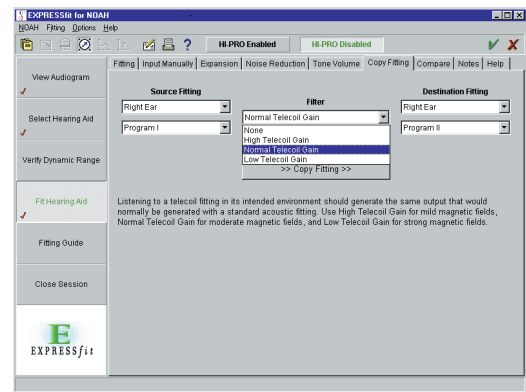


Figure 2

levels (see Figure 1). Electroacoustic boundaries were set for the microphone program at the 55 and 67 dB SPL input levels to determine the Nordic Standard boundaries for this particular program. Telecoil performance was measured in a 2-cm³ coupler using a FONIX 6500 analyzer. A pure tone sweep was performed at an input level of 10, 31.6 and 100 mA/m using four different telecoil filter conditions (no telecoil filter, low-gain filter, normal-gain filter, and high-gain filter as shown in Figure 2).

RESULTS

Different telecoil filter settings were required to accommodate the various magnetic field strengths (see figures 3–5). The solid upper and lower boundaries define the performance range of the telecoil that matches the microphone as defined by the Nordic Standard. The diamond symbols depict actual

telecoil performance measures using the different filter settings available in the EXPRESSfit software.

As shown in Figure 3, the device approximated the performance defined by the Nordic Standard even without the use of a telecoil filter. Telecoil performance was below the pre-established boundaries at the lower frequencies

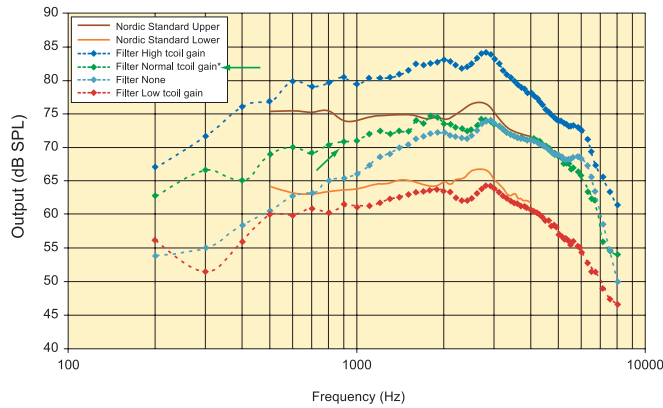


Figure 3. Optimal Telecoil Filter Setting in a 31.6 mA/m Inductive Magnetic Field

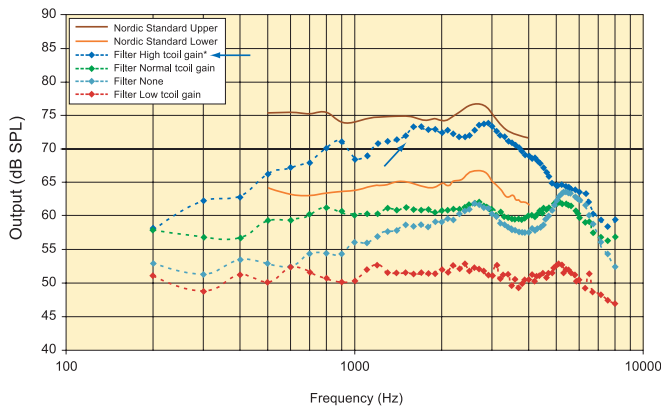


Figure 4. Optimal Telecoil Filter Setting in a 10 mA/m Inductive Magnetic Field

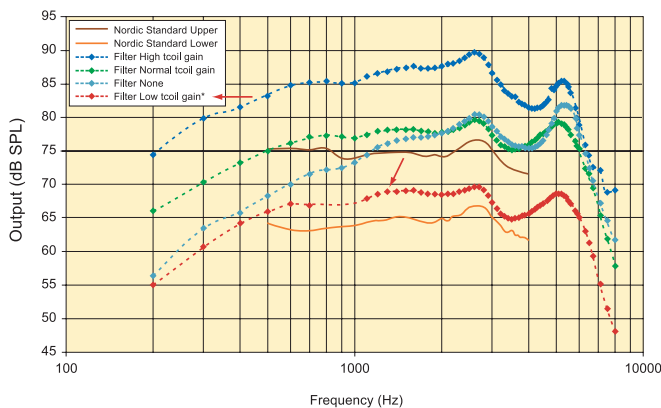


Figure 5. Optimal Telecoil Filter Setting in a 100 mA/m Inductive Magnetic Field

where the telecoil is inherently at its weakest when compared to the microphone. Applying the “normal-gain” filter allowed for an optimized frequency response that fell within the prescribed boundaries and allowed for optimized telephone performance.

Failure to apply an appropriate telecoil filter in weak or strong magnetic fields will also lead to inadequate telecoil performance (figures 4–5). Specifically, a high-gain filter should be applied in the weaker, 10 mA/m magnetic field. Weaker fields may approximate the field strength of an improperly positioned telephone receiver in relation to the hearing device. A low-gain filter is optimized for strong inductive fields that may be typically found in room loop systems (100 mA/m). This low setting is also appropriate when the listener is making use of a telephone amplifier that serves to enhance the inductive field strength arriving at the telecoil.

DISCUSSION

The use of a microphone-to-telecoil transfer function to optimally program telecoils takes the “guesswork” out of programming appropriate frequency-specific levels. Although the Nordic Standard only applies to 31.6 mA/m fields, extending it to include weaker and stronger inductive fields appears to be a reasonable proposition.

The question remains whether applying such a standard actually leads to improved satisfaction with telecoil use. Preliminary results from an ongoing study suggest that, on the telephone, subjects prefer either the normal or high-gain telecoil filter settings. One reason for the high-gain preference may stem from poor device/telephone positioning or perhaps telephone receivers that produce less than the desired 31.6 mA/m induction field. Interestingly, some subjects reported that the high-gain setting was too loud, a comment not often heard in the context of telecoils. Given the great variability found in the inductive magnetic field produced by different telephone receivers, it may be desirable to initially program each device in a pair with a different filter setting. For example, a normal telecoil filter may be programmed into the right device, while a high-gain filter could be selected for the left instrument. The user could be asked to report their preference during a follow-up visit.

One caveat with using the high-gain setting is the potential for the unwanted amplification of stray magnetic fields such as those produced by computer monitors, electric motors, and other such sources. The use of an amplified telephone receiver can lessen the gain requirements and reduce the impact of these unwanted electromagnetic sources.

Judging from the preliminary data, application of a telecoil transfer function, as prescribed by the Nordic Standard, appears effective and facilitates communication over the telephone.

REFERENCES

1. European Committee for Electrotechnical Standardization (1995). Hearing aids part 1: Hearing aids with induction pick-up coil input. IEC 118. 1.

Presented at the American Academy of Audiology 12th Annual Convention on March 16-19, 2000, in Chicago, Illinois.

