

ER-3A ABR INSERT EARPHONE

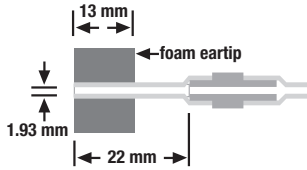


Figure 1

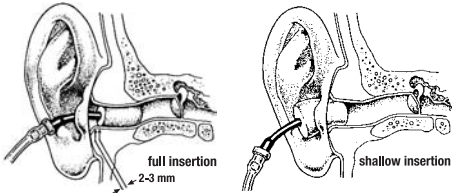


Figure 2

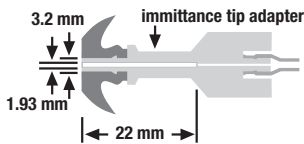


Figure 3



Figure 4

ANSI S3.6 AND ISO 389.2 REFERENCE THRESHOLDS

Sound Pressure Levels in dB re. 20µPa

Frequency (Hz)	Occluded Ear Simulator	HA-2 with Rigid Tube	HA-1
125	28.0 (98.0)	26.0 (96.0)	26.5 (86.5)
250	17.5 (87.5)	14.0 (84.0)	14.5 (84.5)
500	9.5 (79.5)	5.5 (75.5)	6.0 (76.0)
750	6.0 (76.0)	2.0 (72.0)	2.0 (72.0)
1000	5.5 (75.5)	0.0 (70.0)	0.0 (70.0)
1500	9.5 (79.5)	2.0 (72.0)	0.0 (70.0)
2000	11.5 (81.5)	3.0 (73.0)	2.5 (72.5)
3000	13.0 (83.0)	3.5 (73.5)	2.5 (72.5)
4000	15.0 (85.0)	5.5 (75.5)	0.0 (70.0)
6000	16.0 (86.0)	2.0 (72.0)	-2.5 (67.5)
8000	15.5 (85.5)	0.0 (70.0)	-3.5 (66.5)

Table 1

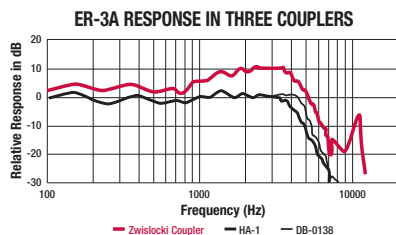


Figure 5

EARTIP COUPLING

Foam eartips developed for ER-3A insert earphones are produced with constant dimensions to ensure proper calibration and test accuracy. To accommodate differences in ear canal size, there are three sizes of foam eartip (small, medium and large). To obtain accurate test results, the following dimensions must be maintained:

1. The length from the end of the eartip to the connection at the end of the earphone tube should be 22 mm (Figure 1). Do not cut the black tubing that connects the foam eartip to the sound tube.
2. The diameter from the end of the eartip to the connection at the end of the earphone tube should be 1.93 mm (Figure 1).
3. Insertion depth should be 14-15 mm into the ear canal, which is achieved when the edge of the foam eartip is 2-3 mm inside the entrance to the ear canal (Figure 2).

NOTE:

- Do not cut the sound tube itself. A change of 10 mm in the length of the sound tube will change the frequency response by 0.5 dB at some frequencies.
- Replace the sound tubes (ER3-04) if they crack or harden.
- Do not reuse foam eartips.

Foam eartips are recommended for most uses; however, immittance probe tip adapters (ER3-06) can be used with commonly used immittance eartips. When using immittance adapters, calibration will be maintained if the eartip is seated on the adapter so that the opening of the eartip is flush with the tip of the adapter (Figure 3). No data are available on the interaural attenuation or noise exclusion of immittance eartips.

INSTRUCTIONS FOR USE

1. Examine the ear canal for obstruction or excessive cerumen.
2. Make sure the sound tube is not blocked.
3. Insert the black tubing of an ER-3A foam eartip completely onto the nipple of the sound tube.
4. Roll the foam tip into the smallest diameter possible (Figure 4).
5. Insert the eartip well into the ear canal. Interaural attenuation is improved with deep insertion.
6. Allow foam to expand to acoustically seal ear canal.
7. Discard foam eartips after a single use.

CALIBRATION IN A 2CC COUPLER

Table 1 shows the Reference Equivalent Threshold Sound Pressure Levels (RETSPLs) measured in three couplers.

The couplers are:

1. An occluded ear simulator as described in ANSI S3.7 and IEC 711 that closely replicates the acoustic properties of the average ear canal and eardrum. ANSI standard 3.6-1996 calls for the HA-2 sound channel to be substituted for the sound channel in the eartip.
2. An HA-1 2cc coupler with the ER-3 eartip sealed to the top surface of the coupler.
3. An HA-2 2cc coupler with Rigid Tube. In this case the sound channel of the coupler is substituted for the sound channel in the eartip.

Audiometer calibration is normally performed at a dial setting of 70 dB HL. The calibration targets shown in parentheses next to the RESPL numbers in Table 1 were obtained by adding 70 dB to each RESPL number.

ER-3A RESPONSE IN THREE COUPLERS

The numbers in Table 1 were chosen to produce the same calibration regardless of coupler. In other words, an earphone calibrated to 70 dB SPL at 1 kHz in either of the 2cc couplers should produce 75.5 dB SPL at the average eardrum or in an occluded ear simulator.

Figure 5 shows the frequency response of an ER-3 earphone measured in each of three couplers. For the Zwischki coupler (ear simulator) curve, the ER-3A eartip was sealed directly into the coupler rather than through an HA-2 sound channel as specified in ANSI S3.6-1996. The response measured with the eartip sealed into the coupler is nearly identical to the average eardrum pressure produced by an insert earphone such as the ER-3A (Sachs and Burkhard, 1972). The HA-2 sound channel introduces an extraneous high-frequency boost in the coupler measurement.

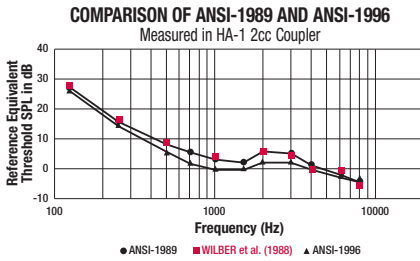


Figure 6

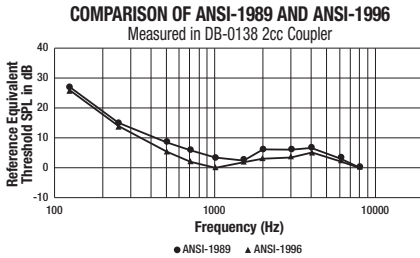


Figure 7

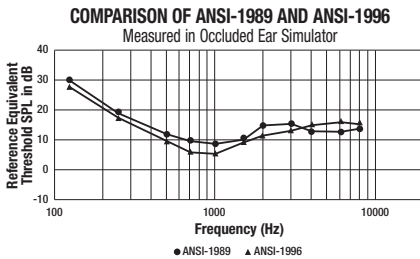


Figure 8

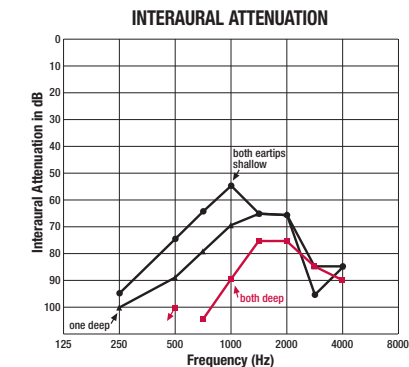
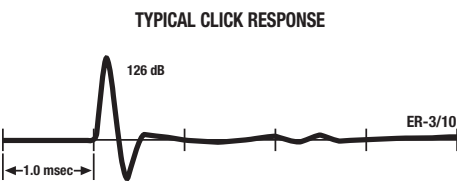


Figure 9



Typical click response of a 10 Ohm ER-3 to a 1 V, 100 μsec click measured on an occluded ear simulator.

COMPARISON OF ANSI S3.6 1989 AND ANSI S3.6 1996

Figures 6 through 8 show the RETSPLs from ANSI S3.6-1989 and ANSI S3.6-1996. The 1996 values were based on only three studies (two European and one US), but were adopted in the U.S. in the interest of international harmony. The 1996 values are, nonetheless, the ones to be used for normal audiometer calibration in order to comply with legal requirements for proper calibration.

For purposes of hearing research, the ANSI S3.6-1989 values should be considered: They were originally based on a compilation of 35 studies from 1928 to 1977 (Killion, 1978), and validated by five threshold studies using the ER-3A insert earphone and summarized by Wilber et al. (1988). The ANSI 1989 ear simulator RETSPL numbers in Figure 8 are the same as the Minimum Audible Pressure at the Eardrum (MAPD) numbers described by Killion (1978).

CALIBRATION FOR SPEECH AUDIOMETRY

Calibration of ER-3A insert earphones for speech is performed by the following method:

1. Set a 1 kHz signal at 0 VU through the speech circuit.
2. Set the attenuator dial to 60 dB HL.
3. Adjust the speech circuit on the audiometer to measure 72.5 dB in a 2-cc coupler.

The ANSI standard specifies that a 1 kHz reference tone level for the speech circuit should be 12.5 dB above a 1 kHz reference test threshold for any earphone. The 1 kHz RETSPL for ER-3A is 0 dB SPL. ($60 + 0 + 12.5 = 72.5$). A range of 69.5 to 75.5 dB meets the ± 3 dB tolerance allowed in the ANSI standard.

EARTIP INSERTION

The purpose of deeply inserted eartips is to maximize interaural attenuation and noise exclusion, but there is usually less than a 3 dB difference in eardrum pressure (i.e., threshold) between shallow and deeply placed eartips.

EXTERNAL NOISE EXCLUSION

ER-3A insert earphones provide greater than 30 dB exclusion of background noise. As insertion depth increases the amount of attenuation increases. Deeply inserted ER-3A foam eartips can provide noise exclusion equivalent to a single-wall booth. Testing to audiometric zero can be done reliably whenever the SPL of the background noise is less than 45 dBA. Figure 10 shows the attenuation of four audiometric earphones. The ER-3A and ER-5A have significantly greater attenuation than traditional supra-aural earphones and circumaural earphones.

INTERAURAL ATTENUATION

Interaural attenuation is significantly higher with insert earphones, making it possible to use lower masking levels in the non-test ear. The interaural attenuation of the ER-3A insert earphone increases with insertion depth. Figure 9 illustrates the importance of deep eartip insertion when maximum interaural attenuation is desired.

SPECIFICATIONS

Impedance: 10 Ohms, 50 Ohms or 300 Ohms

Sensitivity: 102.5 dB SPL in HA-2 coupler at 0.1 Vrms (10 Ohms)
 102.5 dB SPL in HA-2 coupler at 0.2 Vrms (50 Ohms)
 103.5 dB SPL in HA-2 coupler at 0.49 Vrms (300 Ohms)
 Limits ± 3 dB

Maximum output: Meets or exceeds 110 dB HL at standard audiometric frequencies between 0.5 and 4 kHz

Safe operating limits:

Maximum continuous sine wave drive: 2.5 Vrms (10 Ohms), 5 V (50 Ohms), 13.75 Vrms (300 Ohms)

Maximum peak voltage for 1% duty cycle: 10 V (10 Ohms), 20 V (50 Ohms), 55 V (300 Ohms)

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