

**ER-3C
INSERT EARPHONES
for Audiometry**

ETYMOTIC RESEARCH INC.



- Incorporates “touch-proof” electrical connection for safety
- Duplicates ER-3A smooth frequency response
- 30+ dB external noise exclusion – equivalent to a single-wall booth when used with deeply-sealed foam eartips
- 70+ dB isolation (interaural attenuation) between ears; reduces the need for masking
- Reduces test/retest variability compared to supra-aural earphones
- Eliminates test errors due to collapsed ear canals
- Simplifies RECD (Real-Ear-to-Coupler-Difference) measurements
- May be calibrated in a 2-cc coupler, occluded ear simulator, or 0.4-cc coupler

Figure 1 shows a comparison between the ER-3C insert earphone and the original ER-3A earphone. The only difference is at 750 Hz, where the ER-3C earphone has approximately 5 dB greater sensitivity.

Response Comparison: ER-3A & ER-3C measured in HA1 (60318-5) 2cc Coupler
100mV RMS Drive

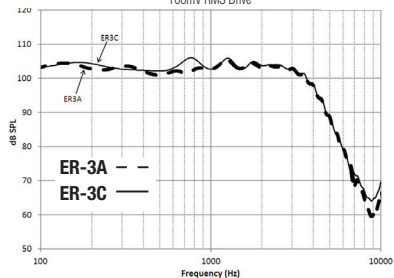


Figure 1

ER-3A & ER-3C have identical RETSPL calibrations

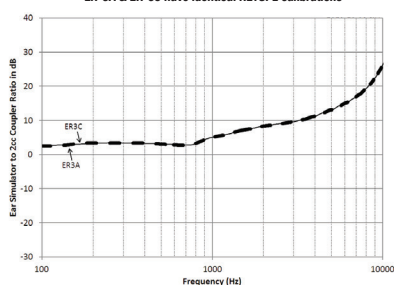


Figure 2

Figure 2 shows the nearly identical relationship between 2-cc calibration and eardrum pressure, represented by measurement in an ear simulator. Both the Zwislocki coupler and the GRAS ear simulator produce sound pressure levels similar to that of an average human ear.

SYSTEM INCLUDES

- ER-3C earphones (10 Ohm or 50 Ohm)
- 7' cable with dual-mono 6.33 mm (1/4") plugs
- 20 foam eartips (regular, 13 mm)
- 20 foam eartips (small, 10 mm)
- 2 foam eartips (large, 18 mm)
- Hook-and-loop neck strap

SPECIFICATIONS

Impedance: 10 Ohms or 50 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)

Temperature: 15-35 °C

Relative Humidity: 30-90% (non-condensing)

Ambient Pressure: 98-104 kPa

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 Vrms (50 Ohms)

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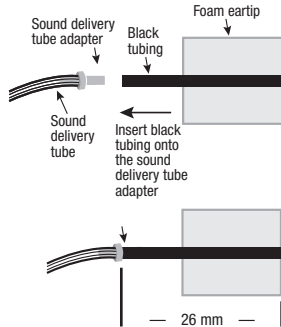


Figure 3

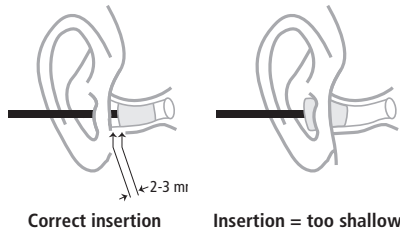


Figure 4

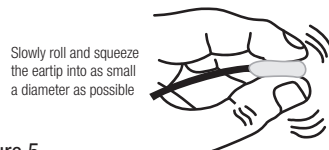


Figure 5

EARTIPS

- Foam eartips are recommended for most uses. They are available in three sizes: standard 8-13 mm (ER3-14A), small 6-9 mm (ER3-14B) and large 10-14 mm (ER3-14C).
- Infant eartips are available in two sizes: (ER3-14D 3.5 mm and ER3-14E 4 mm).
- Multiple sizes of Single-Use Eartips™ 3 mm-16 mm (ER10D-T series) commonly used in immittance and otoacoustic emissions testing can be used with immittance probe tip adapters. (ER3-06X). No data are available on the interaural attenuation or noise exclusion of immittance eartips.

⊗ All eartips, regardless of material or construction are for single person use only. Replace eartips for each test session. Do not reuse eartips.

EARTIP COUPLING

Foam eartips developed for ER-3C Series insert earphones have dimensions that ensure proper calibration and test accuracy.

1. The length of black tubing from the end of the sound tube adapter through the foam eartip is 26 mm. Do not cut the black tubing that connects the foam eartip to the sound tube. (Figure 3)
2. To obtain the noise exclusion and interaural attenuation, consult the ER-3C Calibration Manual. Insertion depth should be 14-15 mm into the ear canal. This depth is achieved when the outside edge of the foam eartip is 2-3 mm inside the entrance to the ear canal. (Figure 4)
3. To facilitate placement, firmly roll eartip into the smallest diameter possible before inserting it into the ears. (Figure 5)

NOTES

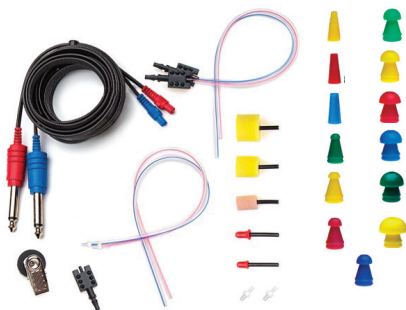
- Do not cut the sound delivery tube. A change of 10 mm in the length of the sound tube will change the frequency response by 0.5 dB at some frequencies.
- Replace the sound delivery tubes (ER3-21) if they crack or harden.
- When using immittance adapters, calibration will be maintained if the eartip is seated on the adapter so that the opening of the eartip is flush with the tip of the adapter.

CARE AND CLEANING

- Use a damp cloth to wipe down any parts that become soiled during normal use.
 - An antimicrobial such as WAVICIDE-01® is safe for external surfaces.
 - Any other agents must be tested before using to prevent damage.
- Do not submerge earphones in any liquid or allow liquid into the sound delivery tubes.
- Do not use alcohol or other strong chemicals or solvents to clean earphones or any parts, including cables, sound delivery tubes and eartips.

ACCESSORIES

Accessories and replacement parts are available from Etymotic Research, Inc. and its authorized distributors.



ER-3C INSERT EARPHONES for Audiometry

ANSI S3.6 (2010) AND ISO 389.2 (1994) REFERENCE THRESHOLDS
Sound Pressure Levels in dB re. 20µPa

Frequency (Hz)	Occluded Ear Simulator	HA-2 with Earmold Simulator	2-cc Coupler HA-1	0.4-cc Coupler (Provisional)
125	28.0 (98.0)	26.0 (96.0)	26.5 (96.5)	33.0 (103.0)
250	17.5 (87.5)	14.0 (84.0)	14.5 (84.5)	25.5 (95.5)
500	9.5 (79.5)	5.5 (75.5)	6.0 (76.0)	18.0 (88.0)
750	6.0 (76.0)	2.0 (72.0)	2.0 (72.0)	13.5 (83.5)
1000	5.5 (75.5)	0.0 (70.0)	0.0 (70.0)	12.0 (82.0)
1500	9.5 (79.5)	2.0 (72.0)	0.0 (70.0)	12.0 (82.0)
2000	11.5 (81.5)	3.0 (73.0)	2.5 (72.5)	14.5 (84.5)
3000	13.0 (83.0)	3.5 (73.5)	2.5 (72.5)	14.5 (84.5)
4000	15.0 (85.0)	5.5 (75.5)	0.0 (70.0)	13.0 (83.0)
6000	16.0 (86.0)	2.0 (72.0)	-2.5 (67.5)	10.5 (80.5)
8000	15.5 (85.5)	0.0 (70.0)	-3.5 (66.5)	10.5 (80.5)
Speech				
1-kHz Cal. Tone	18 (88.0)	12.5 (82.5)	12.5 (82.5)	24.5 (94.5)

Table 1

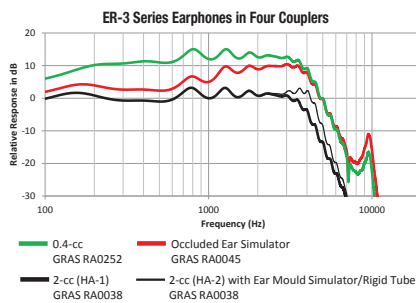


Figure 6

CALIBRATION IN FOUR COUPLERS

Table 1 at left shows the Reference Equivalent Threshold Sound Pressure Levels (RETSPLs) measured in four couplers. Audiometer calibration is normally performed at a dial setting of 70 dB HL. The calibration targets shown in parentheses next to the RETSPL numbers at left were obtained by adding 70 dB to each RETSPL number.

FREQUENCY RESPONSE IN FOUR 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 2-cc couplers should produce 75.5 dB SPL at the average eardrum or in an occluded ear simulator.

The graph in Figure 6 shows the frequency response of an ER-3 Series earphone measured in four couplers. For the Ear Simulator curve, the ER3 eartip was sealed directly into the coupler rather than through an HA-2 sound channel as specified in ANSI S3.6-2010. The response measured with the eartip sealed in the coupler is nearly identical to the average eardrum pressure produced by an insert earphone such as the ER-3 Series (Sachs and Burkhard, 1972). The HA-2 sound channel introduces an extraneous high-frequency boost in the coupler measurement.

CALIBRATION FOR SPEECH AUDIOMETRY

To calibrate ER-3C insert earphones for a speech signal:

- Set a 1-kHz pure tone signal at 0 Volume Units (VU) through the speech (microphone) circuit
- Set the audiometer attenuator to 70 dBHL
- Adjust the speech circuit on the audiometer to measure 82.5 (70.0 + 12.5) dB SPL in a 2-cc coupler. A range of 79.5 to 85.5 meets the ± 3 -dB tolerance allowed in the standard.

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-3 Series earphones is 0 dB SPL. ($70 + 0 + 12.5 = 82.5$). A range of 79.5 to 85.5 dB meets the ± 3 dB tolerance allowed in the ANSI standard.

RELIABILITY

Figure 7 shows the standard deviations for TDH and ER-3 Series earphones. Traditional supra-aural earphones have limitations. Among them are:

1. Poor noise exclusion at low frequencies, which invalidates tests done outside a sound booth.
2. Low interaural attenuation.
3. Erroneous high-frequency thresholds resulting from collapsed ear canals when using traditional MX-41AR earphone cushions.

Insert earphones eliminate all three of these problems.

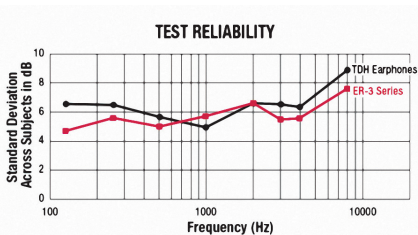


Figure 7

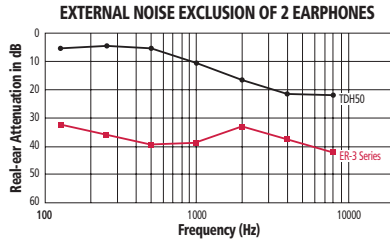


Figure 8

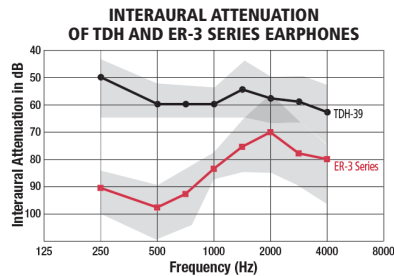


Figure 9

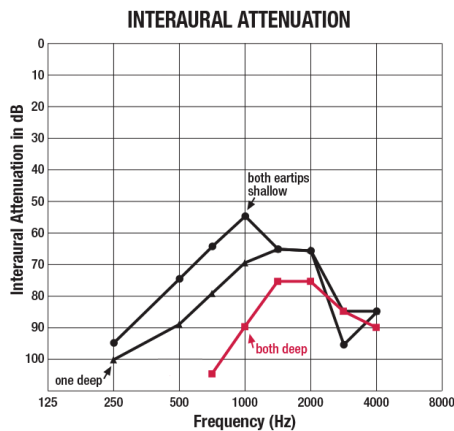


Figure 10

EXTERNAL NOISE EXCLUSION

ER-3 Series insert earphones provide greater than 30-dB exclusion of background noise. As insertion depth increases, the amount of attenuation increases. Deeply-inserted ER3 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 8 shows the attenuation of two audiometric earphones. ER-3 Series insert earphones have significantly greater attenuation than traditional supra-aural earphones and circumaural earphones.

INTERAURAL ATTENUATION AND MASKING

A comparison of the interaural attenuation of a TDH-39 and ER-3 Series insert earphone is shown in Figure 9. High interaural attenuation values reduce the need for masking air conduction thresholds when using insert earphones. In cases of severe bilateral conductive hearing loss, a masking dilemma (overmasking) occurs when a high level of masking in the non-test ear reaches the opposite (test ear) cochlea via bone conduction and elevates threshold in the test ear. Interaural attenuation is significantly higher with insert earphones, making it possible to use lower masking levels in the non-test ear.

Interaural attenuation of ER-3 Series earphones increases with insertion depth. Figure 10 illustrates the importance of deep eartip insertion when maximum interaural attenuation is desired.

⚠️ WARNINGS

- Do not use insert earphones when medically contraindicated, e.g., draining ear, infection, ear canal laceration or other otologic condition where use of insert earphones could potentially exacerbate a medical condition.
- ER-3 Series earphones can produce high sound pressure levels. Use caution when selecting presentation level and duration.
- Reliable test results can be obtained with ER-3C earphones only when the audiometric equipment they are used with is calibrated before initial use and at subsequent intervals as specified by the audiometric equipment manufacturer, in compliance with national and international standards and regulations.
- ER-3C earphones are available in 10-Ohm and 50-Ohm impedance. It is essential that the correct impedance be used in accordance with the specifications of the audiometric equipment. Labels on the earphones identify the earphone impedance.
- Use of accessories or replacement parts other than those supplied by Etymotic Research or its authorized distributors may result in inaccurate results.
- Modification or alteration of any parts may invalidate test results. Example: The sound delivery tube should not be cut. A change of 10 mm in the length of the sound delivery tube will change the frequency response by 0.5 dB at some frequencies.
- Do not use in or near strong magnetic fields (e.g., MRI).
- Do not reuse eartips. All eartips, regardless of material or construction are for single-person use only. Replace eartips for each test session.