

OUT Series for the STM100C



OUT100 Mono headphones

The OUT100 is a monaural, wide response, high efficiency headphone compatible with the STM100C. It's typically used with the STM100C in applications where audio feedback is required while monitoring a specific physiological signal; the most common application for the OUT100 is the audio monitoring of EMG as data is being recorded. The OUT100 weighs 3 ounces and includes a 1.8-meter cord.

OUT101 Tubephone

The OUT101 is a single channel tubeophone compatible with the STM100C. It has a response that can be matched to audiometric headphones (TDH-39, TDH-49, and/or TDH-50). Because the OUT101 uses a flexible plastic tube to couple the sound energy to the eardrum, two advantages result when comparing to conventional audiometric headphones:

- 1) Significant ambient noise reduction is obtained, which is useful for testing performed outside of a standard audiometric test booth.
- 2) The tube itself creates a 1 ms delay in the auditory signal, so electrical artifact can be easily separated from true response in auditory evoked response applications.

The OUT101 is typically used with the STM100C in auditory evoked response applications like the ABR. It measures 3.8 cm x 5 cm x 1 cm, and has a clip attached to secure to fabric or fixtures. Each Tubeophone set includes one plastic tubeophone, 50 foam ear inserts, and a 2-meter cable.

OUT102 Piezo Audio Transducer

The OUT102 piezo transducer is typically connected directly to the STM100C stimulator module. When the stimulator module output rises above 1.5 volts, the piezo indicator will emit a constant audible signal (3.0 kHz @ 80dB). Accordingly, the device is very useful for providing an audible stimulus, or alarm, when a physiological signal passes a certain threshold. As such, the OUT102 makes an excellent audible BPM indicator for ECG, blood pressure or respiration signals. The device can also be used to indicate when temperature or other slowly moving variable (e.g. electrodermal response) passes a certain threshold. The threshold for the OUT102 is determined by adjusting the amplitude control on the STM100C module. The specific Biopotential or Transducer amplifier signal monitored can be recorded while simultaneously directed through the STM100C module. The OUT102 also connects directly to the UIM100C digital I/O ports for operation with Control Channel outputs. The OUT102 measures 2.5cm (dia) x 1cm (high) and comes equipped with a 1.8m cable terminated in a 3.5mm phone plug. An adapter is included for connecting the OUT102 to the UIM100C digital I/O ports.

OUT Series Calibration

The OUT series does not require calibration.



Auditory Systems

Instructions for the use of

E-A-RTONE[®] 3A

Insert Earphones

*Revised 1997 per ANSI S3.6-1996 and ISO 389-2:1994
12/99*



INTRODUCTION

Congratulations on the purchase of your new E-A-RTONE® 3A Insert Earphones. Whether you are performing hearing screening in an educational or industrial setting, testing related to the fitting or evaluation of amplification, audiological research, or comprehensive diagnostic assessment, E-A-RTONE 3A Insert Earphones provide many advantages that can enhance test reliability and minimize or eliminate problems frequently encountered with supra-aural headphones.

Because the subject's external canal is sealed with an E-A-RLINK® foam plug, which functions as a sound delivery system while at the same time attenuating ambient noise, reliable threshold measurement can be accomplished in environments previously unsuitable for hearing testing.

Direct coupling also produces much greater sound separation between ears across the test frequency range. Clinically, that means more instances where the need for masking is eliminated, or the level necessary for effective masking is lower. Your average testing time will decrease without sacrificing reliability. The method of clinical masking you use does not need to be altered. Simply substitute the greater inter-aural attenuation values cited in the *Obtained Interaural Attenuation* table in section I. of this booklet.

E-A-RLINK foam plugs are available from your distributor in three sizes; a standard (3A) plug that will comfortably fit most adult ear canals, a pediatric (3B) size for small canals, and an extra large (3C) size for very large or surgically altered ear canals. Disposable plugs also insure that sanitary conditions exist for each of your patients, and that periodic cleaning of a headband or cushion is no longer required.

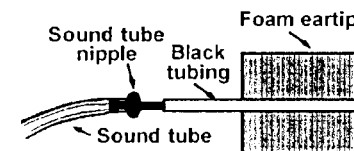
The E-A-RTONE 3A Insert Earphone is offered with three levels (10Ω, 50Ω, & 300Ω) of impedance to match the output of most commercially available audiometers. Your distributor or Auditory Systems can help you determine which version is appropriate for your equipment.

E-A-RTONE 3A Insert Earphones were designed to mimic the frequency response of the TDH type earphone. It is strongly recommended, however, that the (RETSPL) values and procedure cited in the ANSI S3.6 - 1996 Standard be used in recalibration, before initial use, unless your audiometer was purchased with an E-A-RTONE 3A as the standard transducer, and at least annually thereafter. Measured correction factors can be applied in those cases where it is necessary to alternate between an insert earphone and a supra-aural earphone.

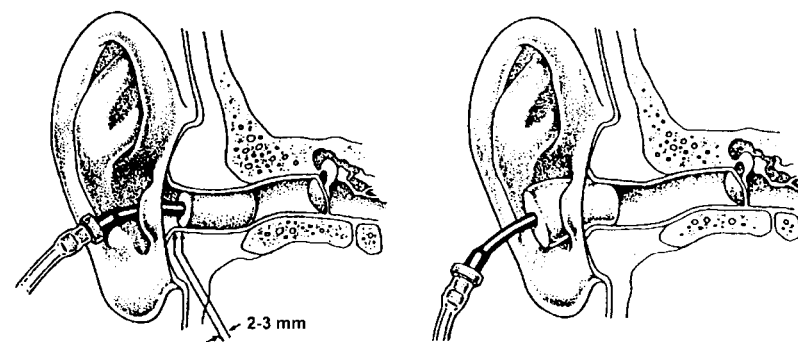
This instruction booklet is intended to provide information to allow you to perform hearing testing with your audiometer and E-A-RTONE 3A Insert Earphones with the confidence that results will be comparable to, or in certain instances more reliable than, measurements performed with supra-aural headphones. Most questions regarding use and calibration of E-A-RTONE 3A Insert Earphones can be answered by reviewing this booklet and/or ANSI S3.6-1996. For information regarding replacement items, please contact your distributor or Auditory Systems Customer Service at 800/624-5955. Requests for technical assistance, or comments regarding E-A-RTONE 3A Insert Earphones and E-A-RLINKS should be directed to Acaro Company Auditory Systems at 317/692-6550.

Although the standard E-A-RLINK 3A fits most ear canals, for smaller ear canals, the smaller diameter E-A-RLINK 3B eartips are available. It is important to obtain a good seal and achieve the proper insertion depth. Insertion procedures are the same for the E-A-RLINK 3A and E-A-RLINK 3B, but deep insertion may be difficult to achieve in extremely small ear canals. In these instances, a shallow placement will have to suffice.

- Secure the section of black tubing, which protrudes from the E-A-RLINK eartips to the sound tube nipple located at the end of the E-A-RTONE sound tube.
- Slowly roll the E-A-RLINK tip into the smallest diameter possible and insert the E-A-RLINK well into the ear canal (see illustrations). Since the eartips are 12 mm long, the correct insertion depth into the ear canal is obtained when the rear edge of the E-A-RLINK is 2-3 mm inside the entrance of the ear canal.
- Hold E-A-RLINK in ear canal until expanded.
- After the test is completed, remove the E-A-RLINK eartips and replace with a new pair for the next subject.



E-A-RLINK



Full Insertion

Shallow Insertion

1. Preliminary Procedures for Use of the E-A-RTONE® 3A

Initially examine the ear canal for obstruction(s) and evaluate the proper size E-A-RLINK disposable foam eartip needed to fit the particular ear canal.

Proper insertion depth is necessary to achieve maximum ambient noise attenuation and interaural attenuation. The graph below depicts interaural

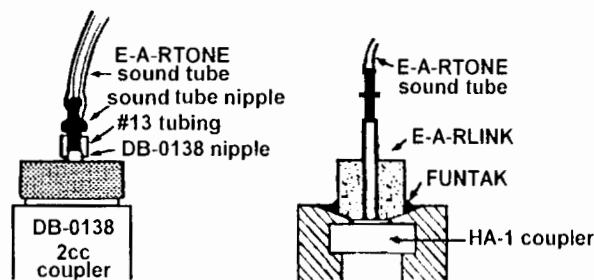
material, the sound output will be affected. To remedy the problem, take the sound tube off at the case nipple and either blow air or push a thin wire through the tube. If the tubes turn yellow or become damaged, replace them with new E-A-RTONE specific parts. It is recommended that the sound tubes be replaced annually.

6. Tubing Characteristics

The consequences of changing the length of the front tubes will be a change in the frequency response of the E-A-RTONE unit. The inner diameter, length and material used in the sound tubes have been carefully monitored by Auditory Systems to achieve maximum accuracy, background noise attenuation and proper frequency response. If replacement sound tubes are needed, use only Auditory Systems approved parts.

7. Pure Tone Calibration

When the E-A-RTONE 3A Insert Earphone is to be used as the primary transducer, the audiometer should be recalibrated using the reference thresholds provided in the standard ANSI S3.6-1996. The standard presents reference thresholds for the HA-1, HA-2 (DB 0138) and Ear Simulator 2cc couplers. However, the Bruel & Kjaer 2cc DB-0138 (HA-2) coupler will simplify the calibration procedure and is recommended. Reference thresholds for DB-0138, IEC 711, and HA-1 couplers are presented below. Should calibration be performed for an audiometer currently calibrated towards ISO-389, the reference thresholds in a 2cc DB-0138 coupler should be used. In order to calibrate the audiometer for direct readings of the hearing thresholds in dBHL using the reference thresholds, the following procedure is recommended. The instrumentation required is a Sound Level Meter with an appropriate condenser microphone calibrated according to the manufacturer's specification. To the microphone, a 2cc coupler, Bruel & Kjaer DB-0138 is attached. The front tube of the E-A-RTONE earphone is connected directly to the coupler (see illustration). Set the intensity dial on the audiometer to 70 dBHL and adjust the output from the audiometer to the SPL-values given for the different test frequencies in the table below. Repeat the procedure for all available test frequencies and in case of a dual channel audiometer, for both channels.



ANSI S3.6-1996 and ISO 389-2:1994 Calibration Values			
Frequency in Hz	Coupler 2cc DB-0138	Coupler IEC 711	Coupler 2cc HA-1
125	96.0	98.0	96.5
250	84.0	87.5	84.5
500	75.5	79.5	76.0
750	72.0	76.0	72.0
1000	70.0	75.5	70.0
1500	72.0	79.5	70.0
2000	73.0	81.5	72.5
3000	73.5	83.0	72.5
4000	75.5	85.0	70.0
6000	72.0	86.0	67.5
8000	70.0	85.5	66.5

8. Correction Factors

Providers who need to switch between insert and supra-aural earphones may do so with properly calibrated equipment. Previously provided "out-of-the-box" correction factors, however, have been judged to be imprecise for clinical work, particularly when used with audiometers that have been calibrated to account for equipment changes over time. Standardized correction factors are therefore not provided. If the audiometer is calibrated for either type of transducer as the primary earphone, measured correction factors for a secondary earphone can be obtained by measuring the output on the appropriate coupler and calculating the difference from the appropriate target value at each frequency. Audiogram correction factors can then be confidently applied for the secondary earphone. The example below outlines the steps, and provides an example worksheet to calculate the correction factors by frequency where the audiometer is calibrated with a supra-aural earphone, and an insert earphone is used as the secondary transducer. In this case, the measured SPLs are the 2cc coupler values obtained with an insert earphone connected to an audiometer calibrated for a supra-aural

earphone, and the Target SPLs are the audiometer HL setting plus the insert earphone RETSPLs for the particular 2cc coupler used. The process will work as well in reverse, i.e. audiometer calibrated for an E-A-RTONE insert earphone with a supra-aural earphone as the secondary transducer, as long as the appropriate Target SPLs (TDH values) are employed.

- Calibrate the audiometer to the appropriate standard for the primary transducer. (TDH-39, 49 or 50 in this example)
- Connect E-A-RTONES to the audiometer.
- Measure the output in a **2cc coupler** and substitute obtained values for the Measured SPLs in the example worksheet below
- Tabulate at each test frequency the difference between actual and target sound pressure levels.
- Apply the rounded correction factors obtained to the audiometer dial readings. Record and post for convenience.
- Repeat the procedure whenever the audiometer is calibrated.

Worksheet example for calculation of individual (insert earphone) correction factors for audiometer calibrated with TDH type earphone										
Frequency in Hz										
	250	500	750	1000	1500	2000	3000	4000	6000	8000
Measured SPLs	90.5	76.8	74.1	72.0	73.4	77.5	79.3	76.5	63.7	58.0
Target SPLs*	84.0	75.5	72.0	70.0	72.0	73.0	73.5	75.5	72.0	70.0
Difference	6.5	1.3	2.1	2.0	1.4	4.5	5.8	1.0	-8.3	-12.0
Rounded Correction	5	0	0	0	0	5	5	0	-10	-10

*Target SPLs = audiometer HL + RETSPL

9. Calibration for Speech Audiometry

ANSI S3.6-1996 specifies the 1 kHz reference-tone level for the speech circuit as 12.5 dB above the 1 kHz pure-tone reference test threshold for the earphone in question. Calibration of the E-A-RTONE for speech is thus performed by setting a 1 kHz signal at 0 VU through the speech circuit, setting the attenuator to 60 dBHL, and adjusting for 72.5 (60.0 + 12.5) dB SPL in the 2cc coupler. A range of 69.5 to 75.5 dB meets the ±3 dB tolerance allowed in the standard.

10. Technical Specifications and Limits for E-A-RTONE 3A

Impedance: 10 Ohm, 50 Ohm or 300 Ohm

1 kHz Sensitivity: 102.5 dB SPL in DB-0138 (HA-2) coupler
 @ 0.1 Volt rms. (10 Ω)
 @ 0.2 Volt rms. (50 Ω)
 103.5 dB SPL in DB-0138 (HA-2) coupler
 @ 0.49 Volt rms. (300 Ω)

Limits: ± 3 dB

Distortion: < 3% measured @ 500 Hz, 118.5 dB SPL

Maximum output: Meets or exceeds 110 dBHL at standard audiometric frequencies between 500 and 4000 Hz

Safe operating limits: Max. continuous sine wave drive:
 2.5 Volt rms. (10 Ω)
 5.0 Volt rms. (50 Ω)
 13.75 Volt rms. (300 Ω)

Max. Peak voltage for 1-% duty cycle:
 10 Volts (10 Ohm)
 20 Volts (50 Ohm)
 55 Volts (300 Ohm)

Accessories supplied:
 50 disposable E-A-RLINK 3A eartips, 50 disposable E-A-RLINK 3B eartips, 4 disposable E-A-RLINK 3C eartips and 213 cm cord (7 feet) with left and right 1/4" mono color-coded phono-plugs.

Data supplied: 2cc-coupler frequency response chart on individual units.

11. Reference Equivalent Threshold Sound Pressure Levels (RETSPLS) According to ANSI S3.6-1996 and ISO-389-2:1994

ANSI S3.6 and ISO 389-2 Reference Thresholds			
Sound Pressure Levels in dB re. 20 µPa			
Frequency in Hz	Coupler 2cc DB-0138	Coupler IEC 711	Coupler 2cc HA-1
125	26.0	28.0	26.5
250	14.0	17.5	14.5
500	5.5	9.5	6.0
750	2.0	6.0	2.0
1000	0.0	5.5	0.0
1500	2.0	9.5	0.0
2000	3.0	11.5	2.5
3000	3.5	13.0	2.5
4000	5.5	15.0	0.0
6000	2.0	16.0	-2.5
8000	0.0	15.5	-3.5

12. Limited Warranty

Aearo Company warrants each insert earphone (sold under the name E-A-RTONE® 3A) it manufactures to be free from defects in material and workmanship under normal use for a period of twelve (12) months from the date of sale to the original purchaser. During this warranty period Aearo Company Auditory Systems will repair or replace, at Auditory Systems sole option, free of charge, any defective part returned with shipping charges prepaid to the Distribution Center listed below. This shall be the sole and exclusive remedy available for a failure under this warranty and for any and all claims arising out of the purchase and use of the product, and the sole obligation of Aearo Company under this warranty shall be limited to repair or replacement of any defective part. Please include the serial number(s) of the product, original date of purchase, and the nature of the problem. Merchandise not returned prepaid will be refused. Warranty service will vary depending on the availability of parts and the workload. There will be charges rendered for product repairs made after our warranty period has expired (twelve [12] months from original date of purchase). Upon request, our Customer Service Department will provide cost estimates for post-warranty repairs.

Our warranty does not cover damage or failure caused by abuse, misuse, abnormal usage, faulty installation, improper maintenance, failure to follow the operation and other instructions found in the written materials provided with the product, or repairs other than those made by Aearo Company Auditory Systems. There are no obligations or liabilities on the part of Aearo Company Auditory Systems for consequential damages arising out of, or in the connection with, the operation, use

or performance of the product including, without limitation, with respect to loss of revenues or profit.

This Warranty is in lieu of all other oral or written, express or implied warranties including, without limitation, warranties of fitness for a particular purpose and merchantability, and there are no warranties that extend beyond the description or duration of this warranty. No representative, agent, dealer or employee of Aearo Company is authorized to give any other warranty or to assume for Aearo Company any other liability in connection with sale or service of the products covered by this limited warranty.

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