



Chapter 1: Introduction and Getting Ready for Hearing Aid Test Box Measures

Catherine Palmer, Ph.D.¹ and Lori Zitelli, Au.D.¹

ABSTRACT

In this chapter you will be introduced to the hearing aid test box equipment and work through how to prepare the equipment so that it is ready to provide the testing you will use to evaluate, fit, and troubleshoot hearing aids and other amplifiers. At the end of this chapter, you will be familiar with terminology associated with hearing aid test box measures and the leveling required with the reference microphone and coupler microphone to ensure that your measurements are accurate and can be interpreted.

KEYWORDS: hearing aid test box, calibration, leveling, coupler, coupler microphone

It is important to make sure your equipment is functioning properly and that you understand how to appropriately connect the hearing aids you want to assess to the equipment. Correct measurements and therefore correct interpretation of data depend on these routine activities. Understanding not only how to complete these procedures but why you are making these measurements or using accessories supports evidence-based practice.

CALIBRATION AND LEVELING

Before you start to use the hearing aid test box for troubleshooting and pre-fitting hearing aids, you need to make sure it is functioning properly. The test box and real-ear probe microphone system should be *calibrated* by an individual knowledgeable in instrumentation calibration. This person owns the necessary equipment to calibrate every 6 months (or sooner if there appears to be a problem). Calibrating involves making measurements

¹Communication Science and Disorders, University of Pittsburgh Medical School, Pittsburgh, Pennsylvania.

Address for correspondence: Catherine V. Palmer, Ph.D., Communication Science and Disorders, Eye and Ear Institute, University of Pittsburgh Medical School, 4th floor, 203 Lothrop Street, Pittsburgh, PA 15213 (e-mail: palmerc@upmc.edu).

Unleashing to Power of Test Box and Real-Ear Probe Microphone Measurement; Guest Editor, Lori Zitelli, Au.D.

Semin Hear 2024;00:1–8. © 2024. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-Li- license, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)

Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

DOI: <https://doi.org/10.1055/s-0044-1786504>.

ISSN 0734-0451.

with standard equipment (sound level meter and appropriate couplers) and making necessary adjustments to ensure that the equipment is producing and measuring correct sound pressure levels. On a daily or weekly basis, the equipment should be *leveled* by the clinician. This is an internal (relative) check on the microphones that are being used for measurement. This section will describe the leveling procedure for the test box. (Note: In the Audioscan manuals and on the Verifit screens, you will see that the term “calibration” is used for leveling; keep in mind you are not calibrating the system using these procedures, you are leveling the system).

The test box system (see Figure 1) is used to measure the functioning of a hearing aid without the patient present. Coupler microphones, reference microphones, and sound sources (speakers) are necessary components to support hearing aid measurements. In addition, cou-

plers (see Figure 5) that allow appropriate connection of hearing aids to the equipment are necessary. For these measurements to be useful, you need something to which you can compare. Each chapter will give you examples of the data you will use to judge the functioning of the hearing aid. There is one measure described in this workbook that uses both the hearing aid test box and the real-ear probe microphone system: real-ear to coupler difference. Therefore, both the test box and the real-ear system need to be leveled to complete that measure. Leveling instructions for the real-ear probe microphone system are provided in Chapter 4.

Imagine you have just arrived in the clinic on a Monday morning, and it is time to check the equipment. You will need to level (often labeled “calibrate”) the hearing aid test box and the real-ear probe microphone system before you see patients.



Figure 1 Parts of the test box. (A) Binaural coupler microphone; (B) reference microphone (left); (C) reference microphone (right); (D) speakers.

Leveling involves playing a known sound level out of the speaker(s) and placing the two microphones that are used for measurements (in the case of the test box, this is the coupler microphone and the reference microphone) as close to each other as possible so that they are receiving the exact same sound (same distance from the loudspeakers). Given that the microphones are essentially in the same space, they should both measure the same sound pressure level. If they do not, the system will adjust sensitivity internally to make a correction. This allows the system to “trust” what the reference microphone is measuring during your testing. The reference microphone will monitor the level being produced by the loudspeakers and the system will make internal adjustments to ensure that the speaker is producing the correct level of sound so what you believe you are presenting is, in fact, the level that is being presented. Let us level the equipment.

Materials Needed for this Activity

For this activity, you will need a hearing aid test box.

Activity 1

1. Remove any couplers from the binaural coupler microphone.
2. Position the test box reference microphone tips at the openings of the coupler microphones (within 1–2 mm) as shown in Figure 2.
3. Close and latch the test chamber.
4. Right-click the mouse and select **Calibration** under **Test box**.
5. Click **binaural link** between the L and R selections. Both the L and R buttons will highlight when binaural operation is active. This lets you make the left and right measurement at the same time. Note: Each side may be leveled separately by selecting L or R, if preferred.
6. Click **Calibrate** and the graph in Figure 3 will appear on the screen (remember, you are really *leveling*).

If you receive an error message indicating that the calibration is invalid, re-position the reference microphones and measure again (the leveling procedure is very sensitive to correct placement of the reference microphones). Also, make sure you have removed any couplers as



Figure 2 Test box leveling setup. Note that the two reference microphones are as close as possible to the coupler microphones.

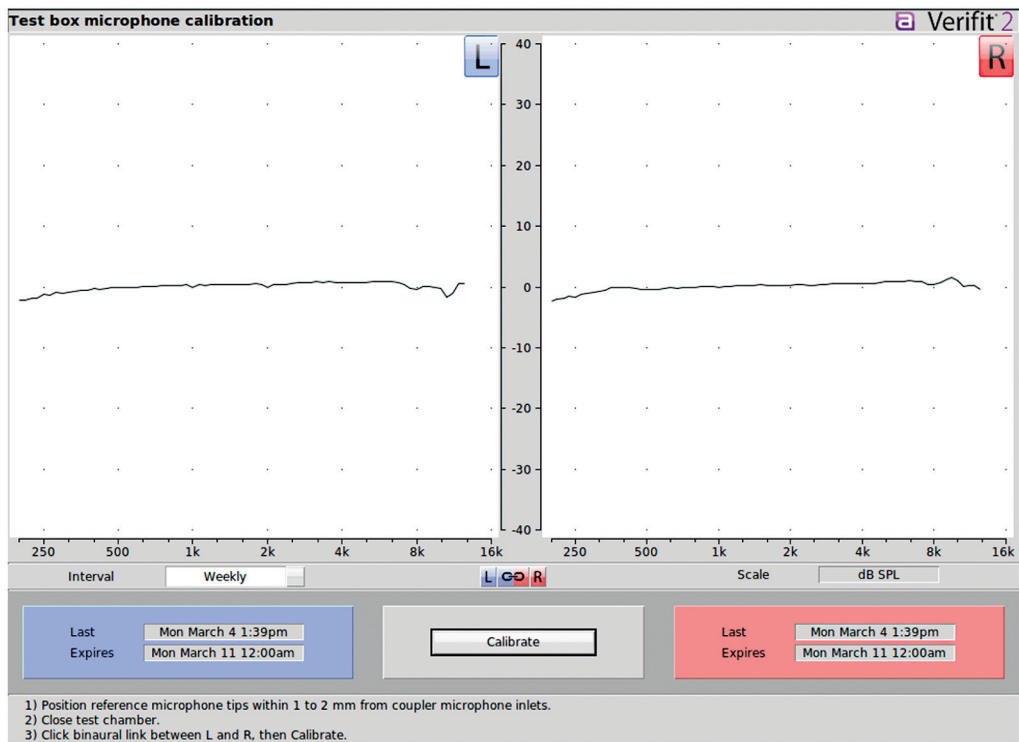


Figure 3 Leveling results.

recommended previously, as leaving a coupler attached to the coupler microphone will result in an invalid measurement.

Materials Needed for this Activity

For this activity, you will need a hearing aid test box.

Activity 2

Level (“calibrate”) the test box using the procedure described earlier. Make sure your graph is similar to the graph displayed in Figure 3. Explain why the reference microphone and coupler microphone must be located in essentially the same place in order for the leveling measurement to be accurate.

The system is measuring the sound measured by the coupler microphone (measurement 1) and the reference microphone (measurement 2). The final display shows one line (not two). If the leveling procedure is successful, this one line will display at “0” (although the y -axis is not

labeled, this is dB SPL). What is producing this line at “0” dB SPL given what you know about the goal of leveling? (Hint: If one sound is produced from the loudspeaker and the two microphones are measuring the exact same level of sound, if you subtract those two results, the difference would be 0 dB SPL across frequency.)

Attaching the Hearing Aid to the Correct Coupler in the Hearing Aid Test Box

Couplers provide a way to connect specific styles of hearing aids to the coupler microphone. The coupler shape (internal dimensions and volume) is constructed to represent an average (male) ear canal. Most importantly, couplers are standard; so, if you make a measurement with a hearing aid connected to a specific coupler in one clinic and you make the same measurement in another clinic (or at the manufacturer), you expect to see the exact same result unless either something has changed in the hearing aid or there is an issue with the microphone.

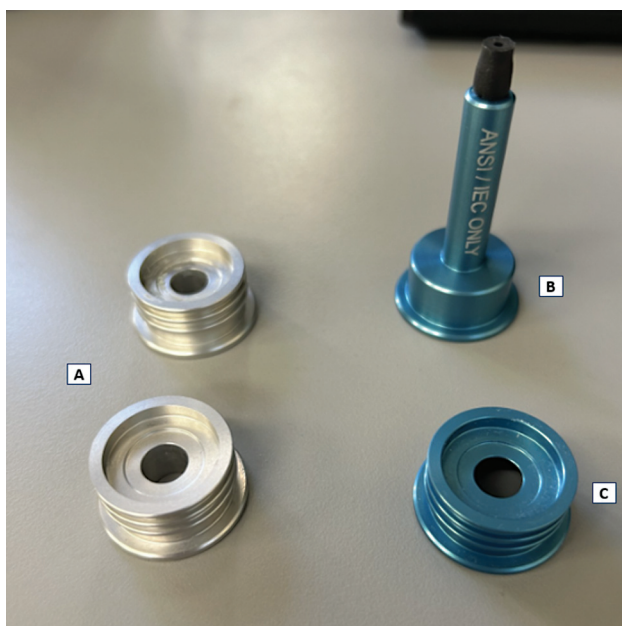


Figure 4 Couplers that are used to obtain the various measurements. (A) Silver (0.4 cc) couplers; (B) blue HA-2 (2 cc) coupler; (C) blue HA-1 (2 cc) coupler.

Improper coupling will yield inaccurate results whether the device is functioning properly or not. You need to be confident that your measurement results are accurate to use these data to make clinical decisions. It is important to understand the use of the different couplers that come with the equipment. The Verifit 2 comes with four couplers. Use the two silver-colored 0.4-cc wideband couplers (Figure 4A) for the test box tests above the division on the menu screen (speech mapping, directional, noise reduction, etc.; see Figure 5). Use the blue-colored 2-cc ANSI couplers (Figure 4B, C) for test box measures below the division with the HA-1 for in-the-ear (ITE) hearing aids and the HA-2 for behind-the-ear (BTE) and receiver-in-canal (RIC) hearing aids (ANSI/IEC, OTC/DTC, Distortion, etc.). There is no standard for testing completely-in-canal (CIC) or invisible-in-canal (IIC) hearing aids, but these hearing aids should be coupled to HA-1 at this time. Let us practice coupling hearing aids to the coupler microphone in the test box.

Materials Needed for This Activity

For these activities, you will need a hearing aid test box and various styles of hearing aids

including a BTE hearing aid, an ITE hearing aid, and a receiver-in-the-ear (RITE) hearing aid (also known as a receiver-in-the-canal [RIC] hearing aid). For these exercises, these do not have to be functioning hearing aids.

Activity 3

Use the instructions below to practice attaching different styles of hearing aids to the correct couplers.

BTE Coupling

1. Attach the HA-2 to the left coupler microphone (see Figure 6).
2. Place the tip of the earhook into the tubing at the end of the coupler.
3. Place the hearing aid with its microphone facing the left reference microphone. The hearing aid should be in the area of the [+] on the foam floor. The reference microphone should be about 2 mm from the hearing aid microphone.

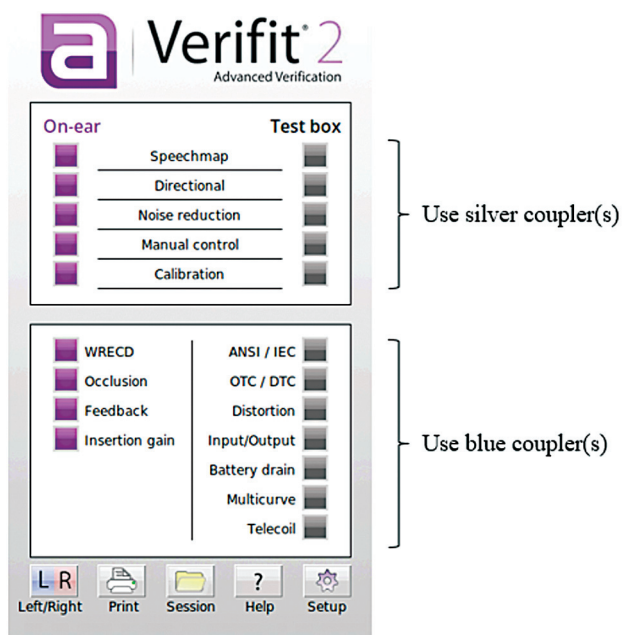


Figure 5 Test menu indicating which set of couplers to use.



Figure 6 Attaching a behind-the-ear to an HA-2 coupler.

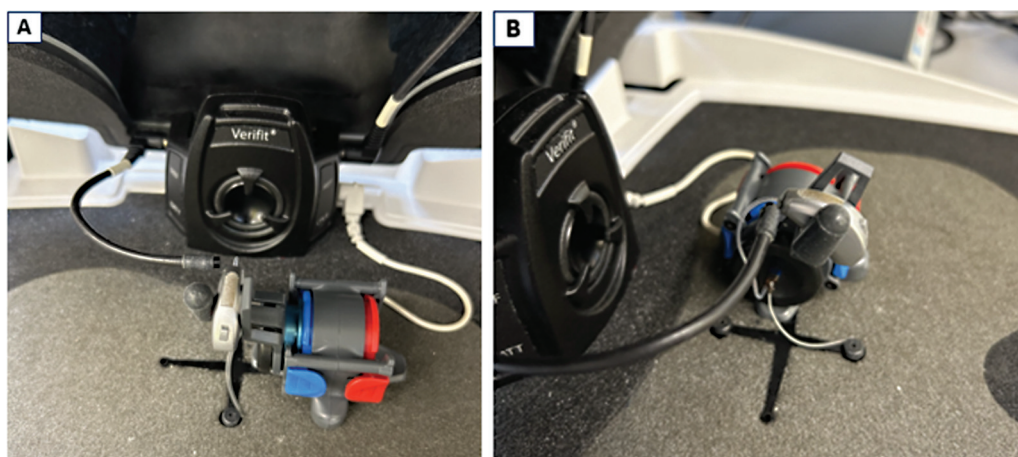


Figure 7 Receiver-in-the-ear/Receiver-in-the-canal coupling: (A) top view; (B) side view.

RITE/RIC Coupling

1. Attach the black rubber thin-tube/RIC (TRIC) adapter to the blue HA-1 coupler (see Figures 7A, B). This adapter allows you to connect RITE/RIC hearing aids to the coupler.
2. Attach the blue HA-1 coupler to the left coupler microphone.
3. Insert the end of the receiver into the black rubber TRIC adapter (first, remove any dome that is on the RITE/RIC hearing aid).
4. Place the hearing aid with its microphone facing the left reference microphone. The hearing aid should be in the area of the [+] on the foam floor. The reference microphone should be within approximately 2 mm of the hearing aid microphone.



Figure 8 Using putty to create a seal between the hearing aid and the coupler.

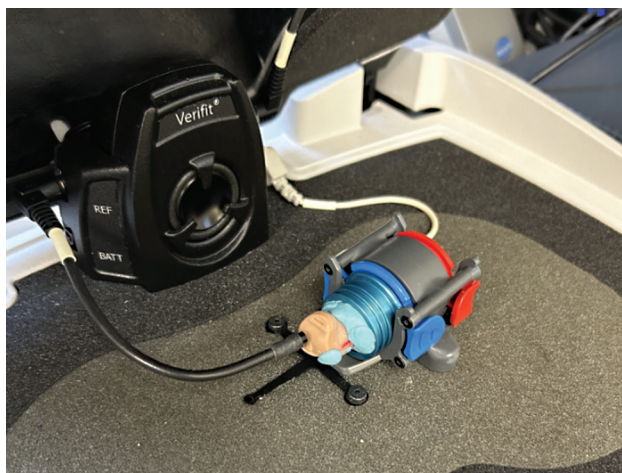


Figure 9 Connecting an in-the-ear hearing aid to the correct coupler using putty.

ITE, ITC, CIC, and IIC Coupling

1. Attach the HA-1 coupler to the left side of the coupler microphone.
2. Roll some putty into a small log shape, wrap it around the canal portion of the hearing aid, making sure not to block the sound outlet (Figure 8).
3. Attach the hearing aid to the HA-1 coupler with putty, aligning the sound outlet with the hole on the HA-1 coupler so that sound can go into the coupler and be measured by the coupler microphone. It is best to make this connection prior to putting the coupler into its position with the coupler microphone so that you can look through and make sure the hearing aid sound outlet is visible and positioned correctly.
4. Seal any vents at the faceplate (outer part of the hearing aid) using putty. If the vent is left
5. Place the reference microphone near the hearing aid microphone (within approximately 2 mm) (Figure 9).

open, you may have inaccurate test box measurements.

CONCLUSION

Now that you know how to level the equipment, you know how to connect hearing aids to the correct couplers, and you know how to place the hearing aids correctly in the test box; you are ready to use the test box to help you fit, evaluate, and troubleshoot hearing aids.

CONFLICT OF INTEREST

None declared.