

Techniques for

# TESTING DIRECTIONAL HEARING AIDS

*Coupler & Real-Ear  
Measurements*

# Testing Directional Hearing Aids

## Coupler & Real-ear Measurements

When fitting a directional aid, it is very important to make sure the microphones of the hearing aid are providing a directional benefit. This is typically done by measuring the response of the hearing aid when the source is in front of the patient—the *forward* response—and the response of the hearing aid when the source is behind the patient—the *reverse* response. You can determine these responses with coupler measurements or with real-ear measurements. The following are techniques you can use on any FONIX analyzer.

## **Coupler Measurements**

When testing a directional aid in the sound chamber, it is important to position the aid correctly in order to test the forward and reverse responses. After the measurements have been completed, compare the forward and reverse responses to each other.

### ***Method 1***

If you have a 7000 Hearing Aid Test System analyzer, or if you have an FP35 analyzer with an external sound chamber, we recommend the following method.

The speaker in our large sound chamber is positioned on the right side at a 45° angle, as illustrated in Figure 1. It is important to keep this in mind when positioning the directional aid for measurements.



Figure 1—Sound chamber with speaker mount

## **Forward measurement:**

- 1. Position the hearing aid so that it is faced towards the sound chamber speaker.** The body of the hearing aid should be facing right, as shown in Figure 2. Close the sound chamber lid when finished.
- 2. Take the forward measurement.** Each FONIX analyzer has a screen to take individual coupler measurements. Use this screen to take the measurement. We recommend using a Composite or Digital Speech signal, if it is available. Typically this measurement should be done so that the test signal is above the noise floor of the testing environment, but below the compression knee point of the aid, if possible. A 50 dB SPL source is a good choice.



Figure 2—Forward positioning in 7020 sound chamber

## **Reverse measurement:**

- 1. Position the hearing aid so that it is faced away from the sound chamber speaker.** Different hearing aids have different null points, so you will want to adjust the positioning so that the sound chamber speaker is pointing towards what should be the null point of the directional aid. See Figure 3. Close the sound chamber lid when finished.
- 2. Take the reverse measurement.** Use the same source type and level as you used for the forward measurement.



Figure 3—Reverse measurement in 7020 sound chamber

## ***Method 2***

If you have an FP35 analyzer, and you are using the analyzer's built-in sound chamber, we recommend the following method.

Since the FP35 analyzer has a small sound chamber, directional testing is best done with the chamber in the upright position that is usually associated with real-ear measurements. The hearing aid, connected to the coupler, can be positioned in front of the speaker on a stand or the back of a chair. In a pinch, the operator can stand to the side of the sound field and just hold the aid at a fixed distance from the speaker.

1. Set up your analyzer so that the speaker is in the upright position. See your operator's manual for details.
2. Position the stand or chair you are going to use to setup the hearing aid. If you are using a chair, face the chair to the side, so that the sound field will not bounce against the large flat surface of the back of the chair. The testing surface should be about 12 inches from the speaker.

3. Use Fun-Tak to affix the large measurement microphone to the testing surface. If you are going to be holding the aid during the test, then hold the measurement microphone about 12 inches from the speaker while standing to the side of the sound field. See Figure 4.
4. Enter the analyzer's coupler multicurve screen and "level" with this positioning.
5. Attach the hearing aid to the coupler and insert the measurement microphone, as usual. You are now ready to test.



Figure 4—Preparation

- 1. Position the hearing aid on the testing surface so that it is facing forward.** Use Fun-Tak to hold the assembly in place. Alternately, hold the hearing aid in place while standing to the side of the sound field. See Figure 5.
- 2. Take the forward measurement.** In the coupler multicurve screen, take the forward measurement. We recommend using a Composite or Digital Speech signal, if it is available. Typically this measurement should be done so that it is above the noise floor of the testing environment, but below the compression knee point of the aid, if possible. If you have a quiet testing environment, use 50 dB SPL. Noisier testing environments may require you to use a higher source level to get a good measurement.



Figure 5—Forward Measurement

- 1. Position the hearing aid so that it is faced away from the sound field speaker.** Different hearing aids have different null points, so you will want to adjust the positioning so that the sound field speaker is pointing towards what should be the null point of the directional aid. Make sure the aid is the same distance from the speaker that you used for the forward measurement. See Figure 6.
- 2. Take the reverse measurement.** Use the same source type and level as you used for the forward measurement. If you are using a Digital Speech or Composite source, you can actually rotate the hearing aid while the measurement is running to determine the null spot of the directional microphones – look for when the response drops the most.



Figure 6—Reverse measurement

## Real-Ear Measurements

Perhaps the most convenient way to test directionality is with a real-ear measurement. You can use the Insertion Gain screen on any FONIX analyzer to show you the forward and reverse responses as well as a curve showing the directional advantage. All you need is a swivel chair to turn the client around during testing, or an external speaker on a swing arm to move the speaker around the client.

Since we're going to use the Insertion Gain screen for this measurement in order to show the difference between the forward and reverse responses, we're going to treat the reverse measurement as the "unaided" measurement and the forward measurement as the "aided" measurement.

1. Set up the analyzer as you would for any real-ear measurement. Use a  $0^{\circ}$  azimuth positioning when you level the sound field speaker. The reference microphone should be OFF for these measurements. (The reference microphone is automatically on during leveling.)
2. After leveling, turn the patient around so the speaker is pointing at the null spot of the directional aid. For some hearing aids this is  $180^{\circ}$ . Other hearing aids may have the null at a different angle. Alternately, if

you are using an external speaker on a swing arm, move the speaker around the patient. See Figure 7.

3. Insert the probe tube into the ear and the hearing aid into the ear.



Figure 7—Reverse Measurement

4. Set up the analyzer to perform an “unaided” measurement in the real-ear insertion gain screen. Although this measurement will be done while the patient is wearing the hearing aid, the analyzer doesn’t need to know this.
5. Select the source signal. Choose Digital Speech, if available. Otherwise, select the FAST (continuous) pure-tone sweep.
6. Select the source level. This level should be low enough that it is below the hearing aid’s compression knee point, but high enough so that the measurement is performed above the noise floor of the room. Usually a signal level of 50 dB SPL is preferable, although you may have to use a louder signal in a noisy test environment.
7. Perform the reverse measurement. While the signal is running, you can adjust the angle of the speaker by moving the speaker or the patient in order to determine the null spot of the directional aid. Look for the angle at which the response curve provides the least amount of amplification.
8. Stop the measurement when satisfied. This is the real-ear reverse measurement.



Figure 8—Forward Measurement

1. Rotate the patient or the speaker so that the speaker is positioned at a  $0^{\circ}$  azimuth for the forward measurement. See Figure 8.
2. Set up the analyzer to perform an “aided” measurement in the real-ear insertion gain screen. Make sure the source type and level are the same as was used for the reverse measurement.
3. Take the forward measurement. The insertion gain graph will show you the amplification benefit of the directional aid. The unaided-aided graph will show you the absolute gain (or SPL) of the reverse and forward measurements. See Figure 9.

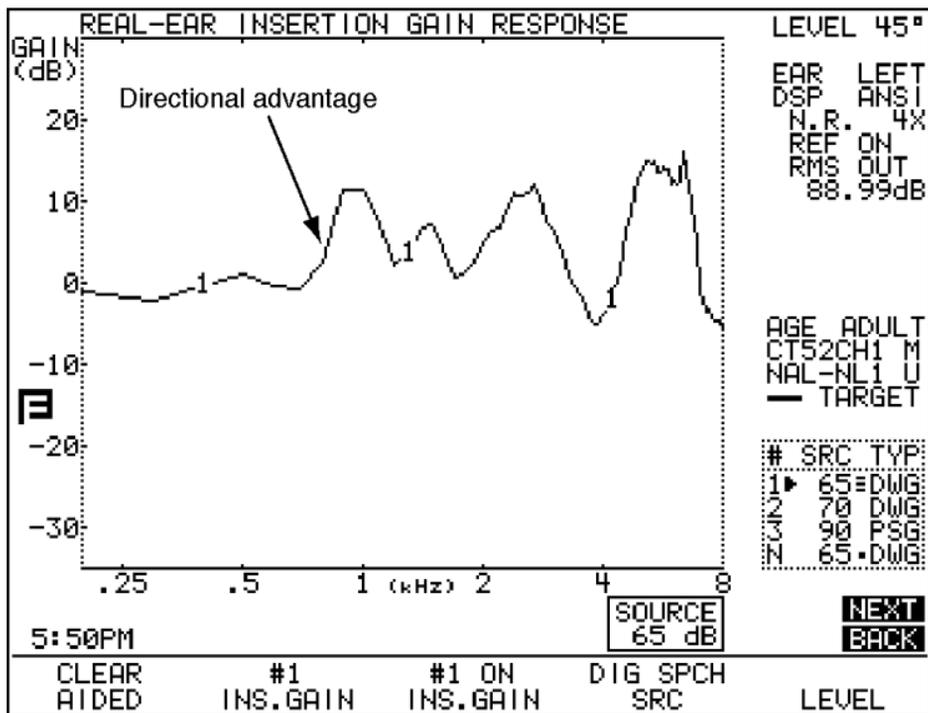


Figure 9—Directional Measurement