

CJS Labs

Technology · Research · Strategy · Solutions

Lab Notes



Electroacoustics & Audio

- Consulting
- Design / Testing
- Training

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Training Services

CJS Labs offers customized in-house training. Our design experience, proven processes, and measurement expertise will make your product development more efficient. Learn how to optimize both your designs and test routines. Having a thorough understanding of fundamentals, correct terminology, and proper techniques will also enable you to make more informed decisions and communicate more effectively with your customers and vendors as well as within your own organization. Understand why certain failure modes are problematic, even if they are not obvious or audible. Sample course outlines and details are available on our website:

http://www.cjs-labs.com/training_seminars.html

Contact us to schedule a training course for your organization.

ASA Standards Award

In June, I received an award at the spring ASA meeting in Boston this for chairing S3 Working Group 37, which completed the revision of the ANSI/ASA S3.7 Method for Measurement and Calibration of Earphones standard. The work took about 18 months and the standard was balloted and published last November.

ASA Standards Manager Neil Stremmel presented the award after the S3 meeting.



News and Recent Developments

AES New York

The AES 143rd Convention takes place 18-21 October in New York City. I will be presenting a tutorial entitled “**Headphones, Headsets & Earphones: Electroacoustic Design & Verification**”, Session PD01 on Wed. 18 Oct. at 10:45am.

<http://www.aes.org/events/143/productdevelopment/?ID=5537>

ISEAT—Shenzhen

I will be presenting the keynote address, entitled “**Why Is Headphone Audio So Poor, and What Can Be Done About It?**” at the

ISEAT symposium in Shenzhen, China 4-5 November. I’m also giving a master class on Loudspeaker Design. <http://www.iseat.org/en/>

ASA Meeting in New Orleans

The Acoustical Society of America meets in New Orleans 4-8 December. I am co-chairing Special Session 3a1D at 7:45am on Wed. 6 Dec. entitled “**Standards: Practical Applications in Acoustics**”. This session will also be live streamed. Stay tuned for details.

<http://acousticalsociety.org/content/174th-meeting-acoustical-society-america#overlay-context=content/174th-meeting-acoustical-society-america>

Let us know if you plan to attend any of these meetings and would like to set up a meeting to discuss your project.

Christopher J. Struck

CEO & Chief Scientist

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“Sound Advice Spanning 3 Decades”

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CJS Labs is a consulting firm based in San Francisco, CA. We specialize in audio and electroacoustics applications. With over 30 years of industry experience in engineering and technology management, our areas of expertise include transducers, acoustics, system design, instrumentation, measurement and analysis techniques, hearing science, speech intelligibility, telephonometry, and perceptual coding. We also offer project management, technology strategy, patent & IP evaluation, and training services

Back issues of Lab Notes are available on our website at:
http://www.cjs-labs.com/lab_notes_links.html

Insertion Gain of Earphones

In general, it is not possible to measure the acoustic response of earphones directly in the free field in the same manner as a loudspeaker, nor would such a measurement have any meaning. Measurements are normally performed on a manikin with an ear simulator at the equivalent of the ear drum. This response, however, does not directly represent the effective or net gain of the device, as some portion of the comparable response in a sound field would occur naturally due to head diffraction effects and the ear canal resonance. Therefore, the effective response of an earphone as perceived by the listener is correctly represented as an *insertion gain*. The conceptual process for determining the insertion gain is shown in Fig. 1.

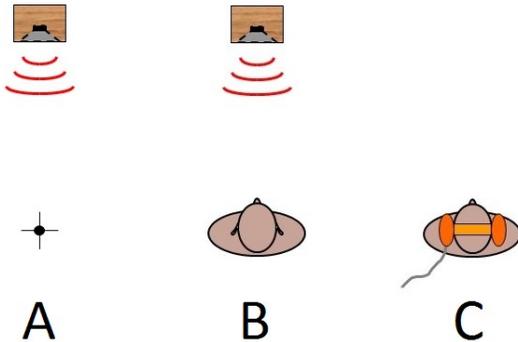


Fig. 1. Insertion gain measurement process.

First, the sound source is measured at the reference position (A). Next, the response at the ear drum is measured (B). Lastly, the earphone response is measured at the ear drum (C). Typical resulting responses are shown in Fig. 2.

Note the rise in the open ear response in the range centered at 2.8 kHz due to head diffraction and the

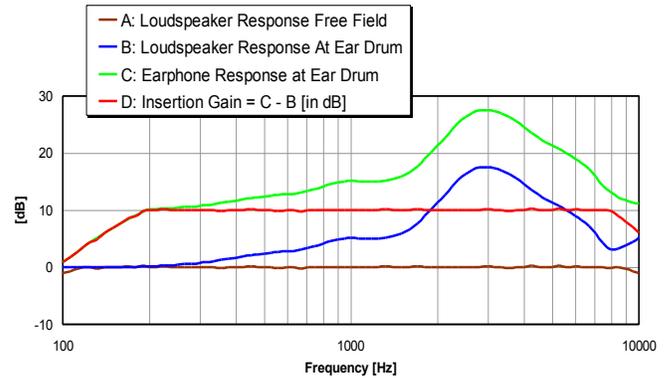


Fig. 2. Measurements for determining the insertion gain of an earphone.

ear canal resonance. In order for the earphone to have a flat perceived response, this feature must appear in the earphone response when measured at the ear drum. The insertion gain of the earphone under test is the difference between the measured ear phone response in the ear simulator and the open ear response, in dB. In this example, the open ear response is free field, on-axis, but this could be diffuse field or some other appropriate target. The desired result is a “flat” insertion gain across the bandwidth of interest, as shown in Fig. 2, curve D.

Therefore, it is the insertion gain that maps to perceived response. This means that if the appropriate target response at the ear drum is met, the result will be the desired flat insertion gain, and measurements on the device under test need only be performed using a manikin with an ear simulator. Both free and diffuse field data are readily available.

Please contact us for more information.