

# CJS Labs

Technology · Research · Strategy · Solutions

# Lab Notes



## Electroacoustics & Audio

- Consulting
- Design / Testing
- Training

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## Training Services

*CJS Labs also 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](http://www.cjs-labs.com/training_seminars.html)*

Contact us to schedule a training course for your organization.

## CJS Labs 10<sup>th</sup> Anniversary

2016 marks CJS Labs 10<sup>th</sup> year. A lot has happened since I first set out as an independent consultant. Here are a few highlights:

**2006:** C. J. Struck departs Tymphony and takes on consulting project work as CJS Labs.

**2007:** CJS Labs is licensed as a Sole Proprietorship in San Francisco. [cjs-labs.com](http://cjs-labs.com) website launched. First electroacoustics seminars.

**2008:** Issue No. 1 of Lab Notes. Seminars with Klippel. KEMAR manikin acquired. NCAC membership.

**2009:** First ALMA Seminar. Membership in IEEE CSNV. AES Headphone tutorial. First expert

witness project and trial deposition. C. J. Struck becomes a AES Journal reviewer.

**2010:** ASA Award for S3.25 as Chair of WG37. First public CJS Labs electroacoustics seminars. 'Electroacoustics Measurements' course notes book. AES paper on impedance data fitting.

**2011:** C. J. Struck becomes Chair of ANSI Standards Committee 3 - Bioacoustics. Acquisition of Brüel & Kjær Type 4128 Head And Torso Simulator. Microphone clinic at AES San Francisco. AES Telephony tutorial. First international seminar in Sydney, Australia.

**2012:** C. J. Struck becomes an ANSI accredited Independent Expert.

**2013:** ASA Award for S3.36 as Chair of WG67. AES paper on headphone response.

**2014:** Loudspeaker Design seminars at the Audio Design Workshop in Silicon Valley and at AES. Loudspeaker Industry Sourcebook interview. First seminars with Listen, Inc. First International training in Shanghai.

**2015:** C. J. Struck appointed ASA Standards Director. Member of IEC TC-29 and Head of US Delegation.

**2016:** CJS Labs celebrates 10<sup>th</sup> Anniversary. Membership in INCE and SMPTE. Invited speaker at FDA. ASA Award for S3.20 as Chair of WG73. Seminars in Poland. AES paper on headphone testing.

## News and Recent Developments

### [Acoustical Society Meeting, in Salt Lake City](#)

ASA will meet 23-27 May in Salt Lake City, UT at the Downtown City Creek Marriott Hotel.

<http://acousticalsociety.org/content/spring-2016-meeting>

Standards Committee meetings take place Monday and Tuesday. I am well booked in meetings, but contact me if you will be there and would like to discuss your project.

### [AES in Paris](#)

The AES 140<sup>th</sup> Convention will take place 4-7 June 2016 in at the Palais des Congrès in Paris.

<http://www.aes.org/events/140/>

I will be attending on my way to client seminars in Poland. If you or others in your organization will be attending and would like to set up a meeting, please contact us.

Please contact us and let us know how we can be of service to you and your organization.

Christopher J. Struck  
CEO & Chief Scientist

**CJS Labs**





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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 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, telephony, 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](http://www.cjs-labs.com/lab_notes_links.html)

## Boundary Effects on Sources at Low Frequencies

A sound source, such as a loudspeaker, will experience an increase in directivity with increasing frequency, as the wavelength of sound becomes small compared to the size of the baffle. As the baffle the driver is mounted on is larger than the driver, this occurs at a lower frequency than for the driver diaphragm itself. The effect on the response is a shelving transition (see Fig. 1), increasing to 6 dB above  $ka = 2$ . where  $k$  is the Wave Number  $2\pi/\lambda$  and  $a$  is the effective radius (i.e., the radius of a flat circular piston with the same surface area). The Directivity Index effectively increases from 0 to 3 dB as the device transitions from radiating spherically (into a full space) to radiating hemi-spherically (into a half space).

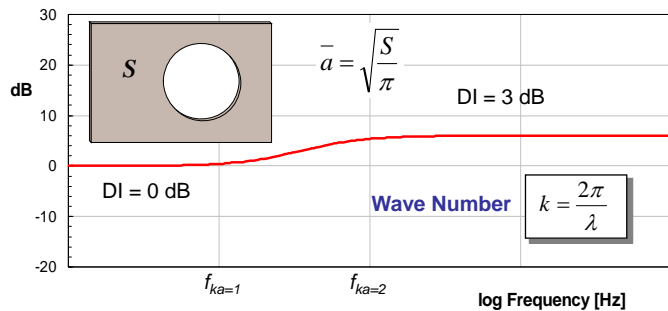


Fig. 1.  $4\pi - 2\pi$  baffle loading vs. baffle size.

So what happens to the free field response of a loudspeaker when it is placed near one or more boundaries?

At very low frequencies, if a sound source is very close to a solid plane boundary (e.g., speaker near a wall), sound radiation will be over a hemisphere (half space) instead of free field (full space), as

sound energy is reflected from the boundary. This halving of the radiation impedance doubles the apparent level, an increase of 6 dB (see Fig. 2). The addition of another perpendicular boundary (e.g., speaker near two walls), again halves the radiation impedance, again doubling the apparent level (+ 12 dB compared to free field). The addition of a third mutually perpendicular boundary (e.g., speaker on the floor and near two walls), halves the radiation impedance and doubles the apparent level yet again (+ 18 dB compared to free field).

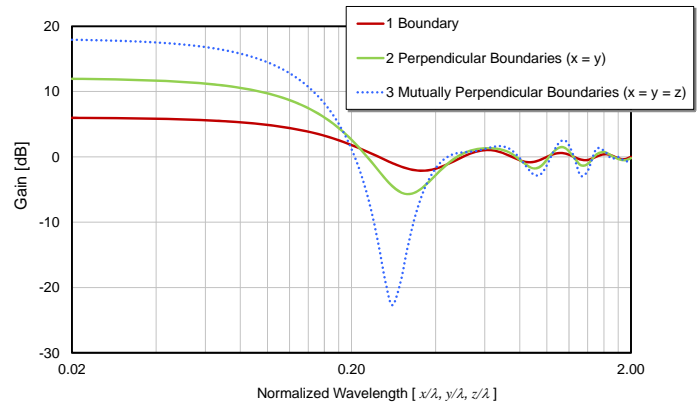


Fig. 2. Influence of boundaries on response, where  $x = y = z =$  Distance to Wall or Floor Boundary

Note that the sound pressure level goes up by 6 dB for each additional boundary. Alternatively, this can be viewed as a progressive increase in the directivity of the source, as the source radiates into a progressively smaller solid angle. There is also a response dip near  $\lambda/4$ , which can be mitigated by careful placement and crossover design.

Please contact us for more information.