

ALMA[®]
INTERNATIONAL

The International Loudspeaker Association



**2009 Winter
Symposium**

***Sound Quality in Loudspeaker
Design and Manufacturing***

January 5-7
Orleans Hotel and Resort
Las Vegas, Nevada

Greetings and Welcome to ALMA International's 2009 Winter Symposium!

Greetings and Welcome to ALMA International's 2009 Winter Symposium!

On behalf of the ALMA Board of Directors, I would like to extend a heartfelt welcome to all ALMA members and guests to this year's Winter Symposium, "Sound Quality in Loudspeaker Design and Manufacturing". The symposium and education committees have done an outstanding job of organizing this event and we hope that our efforts are reflected in the quality of the symposium content.

2009 marks a significant milestone for ALMA. Our first winter symposium was held in 1989 so this is the 20th anniversary of our trademark event. It's unfortunate that the recession has kept many of our regular attendees and exhibitors at home this year. They're certainly missing one of our best programs ever.

A year ago, we set very lofty goals for this event for exhibitor and attendee numbers. Perhaps if we were an organization of economists instead of loudspeaker enthusiasts, we would have known better! Everyone in attendance deserves a special thanks from the Board for making the trip to Las Vegas in spite of our economically troubled times.

This year more than ever, I'd like to thank our exhibitors for their continued support and dedication to the organization. I encourage all of you to spend some time in the exhibit hall reviewing the many fine products and services on display. As always, I hope you enjoy your days here and I look forward to seeing all of you again at future ALMA events.

Steve Tatarunis
Director & Symposium Program Committee Chair

SCHEDULE OF EVENTS

Monday, January 5, 2009

8:00 a.m. – 4:00 p.m.

Training Program (Separate Registration Required)
Loudspeakers and Rooms: Designing Listening Experiences
– Dr. Floyd E. Toole

Room: Salon J

Tuesday, January 6, 2009

8:00 a.m. – 12:00 p.m. & 1:00 p.m. – 5:00 p.m.

Training Program (Separate Registration Required)
Electroacoustic Measurement
– Christopher J. Struck

Room: Salon B

8:00 a.m. – 12:00 p.m.

Training Program (Separate Registration Required)
Applied DSP for Audio Applications
– Paul Beckmann & Al Clarke

Room: Salon C

9:00 a.m. – 12:00 p.m.

Exhibitor-set up

Room: Mardi Gras Ballroom

10:20 a.m. - 11:05 a.m.

Tutorial session - Ron Sauro, NWAALabs

Independent System Testing: How it can help you AND your customers

Room: Salon J

11:10 a.m. – 11:55 a.m.

Tutorial session – Steve Tatarunis, Menlo Scientific
Mini and Microspeakers – A Walk on the Small Side

Room: Salon J

12:00 p.m. – 6:00 p.m.

Exhibit Hall Open

Room: Toulouse Ballroom

12:00 p.m. – 1:00 p.m.

Lunch in the Exhibit Hall

Room: Toulouse Ballroom

1:00 - 3:00pm

Manufacturer Roundtable Discussions

Tolerating Tolerances: Measurements that add value, not cost
Moderated by Stu Lumsden, Polk Audio

(registered participants only)

Room: Salon C

3:00 p.m - 4:00 p.m.

Open Discussions

3:00-3:30: **Consultants** - Survival in an economic downturn

3:30-4:00: **Manufacturing** - Balancing customization & Automation

Room: Exhibit Hall

4:15 p.m. – 5:00 p.m.

Tutorial session - Brian Fallon, Listen, Inc.

Simplifying Loudspeaker Test using the New AmpConnect

Room: Salon J

5:00 p.m. – 6:30 p.m.

Welcome Reception in the Exhibit Hall

Room: Toulouse Ballroom

7:00 p.m.

Members-only Dinner

Yolie's Brazilian Steakhouse
3900 Paradise Rd, Las Vegas.
Transportation on own. Address on page 17.

SCHEDULE OF EVENTS

Wednesday, January 7, 2008

8:00 a.m. – 9:00 a.m.

Breakfast in the Exhibit Hall

Room: Toulouse Ballroom

8:00 a.m. – 6:00 p.m.

Exhibit Hall Open

Room: Toulouse Ballroom

8:00 – 11:30 a.m.

Committee Meetings:

8:00 – Patents and Prior Art

8:30 – Soft Components Sub
Committee

9:30 – AES/ALMA Liaison

10:00 – Standards

11:00 – Education

Room: Salon A

8:30 a.m. – 9:15 a.m.

Tutorial session – Dr. Earl Geddes

*Magnetics Design – Basics and
Simple Analysis*

Room: Salon J

9:20 a.m. – 10:05 a.m.

Tutorial session – John Getz,
Vitrex

*Loudspeaker Applications of AP-
TIV™ Film*

Room: Salon J

11:30 a.m. – 12:00 p.m.

General Assembly Meeting

Room: Salon J

12:00 p.m. – 1:00 p.m.

Lunch in the Exhibit Hall

Room: Toulouse Ballroom

1:00 p.m. – 2:30 p.m.

Invited Papers

1:00 p.m. - 1.25 p.m.

Laurie Fincham, THX & Steve Hutt
Loudspeaker Production Variance

1:30 p.m. - 2.00 p.m.

Stefan Irrgang, Klippel GmbH
*How to cope with production noise
during end-of-line testing*

2:00 p.m. - 2.25 p.m.

Peter Larsen, Loudsoft
*Woofers Design using non-linear
BL(x) curves*

Room: Salon J

2:30 p.m - 3:30 p.m.

Open Discussions

2:30-3:00: Test & Measurement

- Testing without an anechoic
chamber

3:00-3:30: Design - What design
tools do you use in your business?

Room: Exhibit Hall

3:30 p.m. – 5:00 p.m.

Panel Discussion

*What loudspeaker
specifications are relevant to per-
ception?*

Moderator: Floyd E. Toole

Panel:

Steve Temme, Listen, Inc.

Earl Geddes - Consultant

Sean Olive, Harman International

Laurie Fincham, THX

Mike Klasco, Menlo Scientific

Room: Salon J

5:00 p.m. – 6:30 p.m.

Networking Reception in the Exhibit Hall

Room: Toulouse Ballroom

EXHIBITOR DIRECTORY

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TUTORIAL SESSION OVERVIEW

Tuesday, January 6

10:20-11:55am

Room: Salon J

Independent System Testing: How it can help you AND your customers

10:20-11:05am. Salon J

Ron Sauro, NWAALabs

Ron Sauro will speak on the advantages to the manufacturer and designer of Independent testing including phase, GLL (Generic Loudspeaker Library) and increasing the customer base. Then he will use those same criteria to show how the customer will use this information and why it is so important. He will discuss the advantages and disadvantages of single microphone measuring systems and multiple mic systems and the importance of high resolution and high accuracy testing.

Mini and Microspeakers – A Walk on the Small Side

11:10-11:55am. Salon J

Steve Tatarunis & Mike Klasco, Menlo Scientific

Minispeakers and microspeakers surround us in our everyday world. From cell phones to TV's to iPod docks, these tiny transducers deliver music sound and speech from a vast array of devices. In this tutorial, Steve Tatarunis & Mike Klasco of Menlo Scientific will discuss the evolution microspeakers, the similarities and differences between mini and micro as well as critical design areas such as magnet systems and diaphragms (materials, shapes, thicknesses, etc.). Practical methods for achieving extended LF response and higher power handling will also be discussed.

Simplifying Loudspeaker Test using the New AmpConnect

4:15-5:00pm. Salon J

Brian Fallon, Listen, Inc.

Brian Fallon will demonstrate how AmpConnect, a new hardware product from Listen, Inc., efficiently replaces a microphone power supply, power amplifier, impedance reference, and digital I/O with a single rack-mountable piece of equipment, built to withstand the most demanding production environments. He will explain how AmpConnect simplifies production test setups for loudspeakers and other products by eliminating complex cabling and providing a reliable and simple interface to adjust all parameters via USB in SoundCheck® test software.

TUTORIAL SESSION OVERVIEW

Wednesday, January 7

8:30-10:05am

Room: Salon J

Magnetics Design – Basics and Simple Analysis

8:30-9:15am

Earl Geddes

Loudspeaker design expert, Earl Geddes will go through the basic concepts in magnetics starting with simple concepts in magnetic structure design and moving into a more detailed analysis using readily available FEA software. Integration of FEA results into MathCAD will show how $Bl(x)$ curves can be generated. Examples will be shown.

Loudspeaker Applications of APTIV™ Film

9:20-10:05am

John Getz, Victrex

John Getz will present APTIV™ film made with VICTREX® PEEK™ polymer. He will outline how its inherent acoustics, high temperature, mechanical, fatigue and processing attributes make it well suited for use in acoustic film applications and in the manufacture of leading edge, high performance speaker systems and acoustics related components. Its properties and application in the loudspeaker industry will be described in detail, and its application in ATE's P2C speaker cone, a revolutionary speaker cone, made with laminated Victrex APTIV will be described.

MANUFACTURER ROUNDTABLE DISCUSSION

Tuesday, January 6

1:00 - 3:00 pm

Room: Salon C

Moderator: Stu Lumsden, Polk Audio

Groups of participants will focus on generating ideas and solutions to key challenges facing our industry in a truly global environment. The discussion will give you an opportunity to share your ideas with others who face similar challenges and hopefully develop new and better solutions. The topic for discussion is “**Tolerating Tolerances: Measurements that add value, not cost**”. The following questions will be discussed:

Table 1: What are the critical electro-acoustical measurements that need to be made at the end of line testing for transducers and loudspeaker systems? What are practical tolerances for these measurements given the measuring environment and what really matters to audio performance?

Table 2: What process do you use to determine your published (either internal for QC or external for customer reference) product specs? Who determines them (engineering, marketing, manufacturing), and how many tested units are necessary to create or validate these specs?

Table 3: After going through the process of sending a vendor requirements specs/drawing, receiving a quote, ordering tooling, you receive first article samples. What statistical tools do you use to evaluate the parts (either in house or from the vendor)? When you discover some or all of the parameters are outside of the tolerances. What do you do: Do you ask to re-submit or do you change the requested tolerances? What information do you need from a vendor to determine what their process capabilities are?

Table 4: How do you handle the accumulative tolerances that occur in the loudspeaker driver stack up, both the physical stack up and performance stack up of each part (steel properties, magnetics, wire, mass, compliance)? It is sometime surprising the speakers work! Are we really an industry that can be 6 sigma with tight tolerances and low cost or can we do it only on certain parameters? For example, to hold +/- 5% on resonant frequency – is this necessary, is it valuable and how do we know the cost to do so?

Table 5: How do you specify tolerances on subjective criteria. For example how do you specify cosmetics tolerances like color matching and blemish visibility?

Seating is limited to the first 40 who sign up.

Stu Lumsden, Polk Audio

Stu Lumsden is a 30 year veteran of the Loudspeaker industry, designing loudspeaker systems and transducers. He has spent virtually all of that time as an employee of Polk Audio where he is now VP of Engineering. Stu received his BS from Towson University and MS from Johns Hopkins, both located in Baltimore. He is a member of AES, CEA, and R3 Audio Systems Committee, as well as ALMA International, and holds several patents.

PANEL DISCUSSION: “What loudspeaker specifications are relevant to perception?”

Wednesday, January 7

3:30 - 5:00pm

Room: Salon J

Moderator: Dr. Floyd E. Toole.

Moderator

Dr Floyd E. Toole (formerly Harman)

Dr. Toole studied electrical engineering at the University of New Brunswick, and at the Imperial College of Science and Technology, University of London, where he received a Ph.D. In 1965 he joined the National Research Council of Canada, where he reached the position of Senior Research Officer in the Acoustics and Signal Processing Group. In 1991, he joined Harman International Industries, Inc. as Corporate Vice President – Acoustical Engineering. In this position he worked with all Harman International companies, and directed the Harman Research and Development Group, a central resource for technology development and subjective measurements, retiring in 2007.

Dr. Toole’s research has focused on the acoustics and psychoacoustics of sound reproduction in small rooms, directed to improving engineering measurements, objectives for loudspeaker design and evaluation, and techniques for reducing variability at the loudspeaker / room / listener interface. For papers on these subjects he has received two AES Publications Awards and the AES Silver Medal. He is a Fellow and Past President of the AES and a Fellow of the Acoustical Society of America. He has just published a book “Sound Reproduction: loudspeakers and rooms”.

Panelists

Steve Temme, Listen, Inc.

Steve Temme is founder and President of Listen, Inc. a manufacturer of software-based measurement systems for testing electro-acoustic and audio electronic products. Prior to founding Listen, Steve worked for many years as an acoustic test and measurement applications engineer at Brüel & Kjær, and also as a loudspeaker design engineer at Apogee Acoustics. He has authored numerous papers on acoustic testing and lectured extensively throughout the world.

PANEL DISCUSSION (cont.)

Dr. Earl Geddes, Consultant

Earl Geddes began his audio career at a very early age – nearly forty years ago. He has been an AES member since 1978 and an ALMA member since 1999. In that time he has published numerous papers, acted as Central VP, Governor, 91st Papers Chair, Reviewer as well as numerous session chairmanships and local positions for the AES.

He was elected a Fellow of the AES in 1988. Earl holds a BS and MS in Physics from Eastern Michigan University and a PhD in Acoustics from Penn State. He has worked in audio his entire life, mostly with Ford Motor Company but later at Knowles Electronics, - always in the area of audio transducers and systems. Dr. Geddes has received numerous scholarly awards, more than 25 patents, and he has authored two books, Audio Transducers and Premium Home Theater.

Dr. Sean Olive, Harman International

Sean is Director of Acoustic Research for Harman International where he directs the Corporate R&D group, and oversees the subjective evaluation of consumer, professional and automotive audio systems. Prior to 1993, he was a research scientist at the National Research Council of Canada where he worked with Floyd Toole. Sean received his Masters and Ph.D. degrees in Sound Recording from McGill University, and has written over 25 research papers related to the perception and measurement of loudspeakers. For this, he was awarded the Audio Engineering Society Fellowship award (1996), and two Publication Awards (1990 and 1995). Sean is the current Vice President for the AES Western USA-Canada region.

Laurie Fincham, Director of Engineering - THX

Laurie has spent almost the whole of his working career, spanning more than four decades, in speaker design. During that time he has designed drivers and systems for professional, domestic and musical instrument applications. After working for Goodmans Loudspeakers and Celestion he spent 25 years the technical director at KEF Electronics before moving to USA in 1993 to work with Infinity Systems. In 1998 he joined THX, a company founded by George Lucas. He has a keen interest in measuring and modeling methods and while with KEF he developed, along with Mike Berman and Rex Leedham, the first FFT based measurement system in 1971. At THX he continues to pursue a lifetime passion for de-

signing speaker systems and associated electronics. He is a life fellow of the AES and a member of the Acoustical Society of America, and has served as the chairman of the British Section and as a governor and VP International of the AES.

Mike Klasco, President - Menlo Scientific

After graduating New York University, Mike Klasco founded GLI in 1972, one of the first disco audio equipment manufacturers. Post graduate work was in signal processing at NYU in a combined masters/PhD, with the thesis to be completed this century. He sold GLI in 1977 to The Variable Speech Control Company and stayed on for five years. In January 1983 Mike moved to California and founded Menlo Scientific. During the last twenty-five years hundreds of projects have been undertaken for large and small clients, including DuPont, Bell Labs, Monsanto, ExxonMobile, Nike, Intel, Microsoft, Yamaha, Tejin, Cisco, Echelon, 3Com, Armstrong World Industries, Johns Mansville, Owens Corning, Niles, Nu-Tone, Polk, AuraSound, B&C, Klipsch, Ferrofluidics, Transilwrap, Apple, and Acer. Mike has over 300 articles published in many electronics and audio magazines and technical journals and was the Technical Editor of Sound & Communications magazine for ten years, and is presently an Associate Editor of Multimedia Magazine. Invited papers have been presented at the Acoustical Society of America, he has held positions as Session Organizer at the Audio Engineering society, Chairman of the Committee on Acoustics, and member for 35 years. He has half dozen patents licensed or assigned to the Variable Speech Control Company, Yamaha, Armstrong World Industries, and others.

TECHNICAL PAPER SUMMARIES AND SPEAKER BIOGRAPHIES

Wednesday, January 7: 1:00 - 2:30pm

Technical Papers

Room: Salon J

1:00-1:25 pm

Loudspeaker Production Variance - *Laurie Fincham (THX) and Steve Hutt*

Loudspeaker assembly processes and sub-components vary considerably across loudspeaker driver production batches. This should be well understood by loudspeaker designers and users, however ignoring and underestimating these variances and their causes is prevalent. The potential for excessive variation of sensitivity, bandwidth, frequency response and distortion characteristics (etc.) warrants close investigation of expectations, causes of variance and tools and remedies to diagnose and minimize production variance.

Laurie Fincham, THX

Laurie has spent almost the whole of his working career, spanning more than four decades, in speaker design. During that time he has designed drivers and systems for professional, domestic and musical instrument applications. After working for Goodmans Loudspeakers and Celestion he spent 25 years the technical director at KEF Electronics before moving to USA in 1993 to work with Infinity Systems. In 1998 he joined THX, a company founded by George Lucas. He has a keen interest in measuring and modeling methods and while with KEF he developed, along with Mike Berman and Rex Leedham, the first FFT based measurement system in 1971. At THX he continues to pursue a lifetime passion for designing speaker systems and associated electronics. He is a life fellow of the AES and a member of the Acoustical Society of America, and has served as the chairman of the British Section and as a governor and VP International of the AES.

Steve Hutt, Consultant

Steve Hutt has extensive experience designing transducers and audio systems, developing emerging technologies and initiating strategic innovation plans for the audio industry. Currently an independent consultant, he spent many years at Harman/Becker Automotive Systems, starting in product design and more recently managing their global acoustics Advanced Technology Development group. Prior to joining Harman Steve was owner/president of Equity Sound Investments in Toronto, Canada, a

manufacturer and distributor of high-end pro & M.I. loudspeaker systems. He is an active member of the Audio Engineer Society, IEEE and is a former board-member and past president of ALMA. He has published numerous technical papers, and currently has 5 patents issued and several patents pending. Steve attended Berklee College of Music & Humber College of Applied Arts & Technology.

1:30-1:55

How to cope with production noise during end-of-line testing - Stefan Irrgang & Wolfgang Klippel, Klippel GmbH

Achieving fast, accurate and repeatable QC / EOL measurement in the presence of high level, disturbing ambient noise at the end of a production line is a challenge. Loudspeaker defects have very low energy; 80-100 dB below the fundamental may be still audible. Thus even moderate production noise is in the same magnitude as the defects and has to be detected reliably to avoid wrong pass/fail decisions. The following topics will be discussed:

- Detection of critical ambient noise,
- Repeating and merging tests,
- Noise cancellation,
- Using signals immune against noise,
- Test enclosures and design rules.

Stefan Irrgang, Klippel GmbH.

Stefan Irrgang studied electrical engineering at the University of Technology in Dresden, Germany. After graduating in Technical Acoustics in 1994, Stefan Irrgang joined a research team on Active Noise Cancellation Technique applied to mufflers and silencers. In 1997, he received a doctor-engineer degree in Technical Acoustics. He has worked with Klippel since 1998. He is responsible for the Klippel end-of-line test system and for measurement hardware design. He is also involved in signal processing and gives seminars and workshops on loudspeaker diagnostics and optimization. In his spare time he relaxes while playing piano and pipe organ and likes hiking around Dresden, where he lives with his family.

2:00-2:25

Woofer Design using non-linear BL(x) curves - Peter Larsen, Loudsoft

Drivers can either be designed for target Thiele-Small (TS) parameters or target system response in several ways. And the sound quality depends on excursion, shape of the BL(x) curve, Voice Coil offset, amount of steel, compliance linearity, high power stability and so on. In addition there is a demand for cost savings as the material prices have increased

drastically. Practical design examples considering all these aspects will be given.

Peter Larsen, Loudsoft

Peter Larsen, B.Sc. EE. started his career with SEAS in 1974 and was Chief Engineer for Vifa-Speak 1979-1987. Thereafter Dynaudio 1987-1990 and JBL in USA until 1993. From 1993 Peter Larsen has worked as an independent consultant for leading loudspeaker factories all over the world: Audax in France, KEF Audio in UK, Goldmax in China, Vifa-Speak in Denmark, Peerless Fabrikkerne of India, and NXT in UK. During the period as an independent consultant Peter Larsen has specialized in in-depth analysis of loudspeakers and manufacturing techniques, research concerning new components and materials, advanced Acoustic Finite Element modelling, new measuring methods, novel speaker design concepts and development of several customized products (private label). During the same period Peter Larsen has developed and marketed globally special software for speaker development and design.

**ALMA's EIA-426-B
Loudspeaker Power
Rating Test CD**

\$50 – ALMA members
\$100 – Non-members

BUY IT AT THE REGISTRATION DESK!

MEMBERS ONLY DINNER

Join us for our Members Only Dinner at
Yolie's Brazilian Steakhouse
3900 Paradise Rd, Las Vegas.
T: 702-794-0700

Tuesday January 6th at 7pm.

Enjoy an endless supply of succulent Brazilian style meats served at the table, together with all the traditional side dishes. And don't forget the legendary caipirinhas...

A few spaces are still available - sign up at the registration desk!

Wine at the dinner is kindly sponsored by:

Steve Tatarunis, Menlo East
Dan Digre, MISCO



A FORUM FOR THE GLOBAL LOUDSPEAKER INDUSTRY

- ALMA provides a unique forum for the exchange of loudspeaker ideas. No other organization in the world is devoted solely to the loudspeaker industry.
- ALMA covers the industry vertically, from parts to raw drivers to amplified speaker systems. It covers all markets including automotive, professional, commercial, consumer audio and multimedia.
- ALMA sets technical standards for the industry and coordinates international standards with AES, EIA and IEC.
- ALMA provides efficient access to suppliers and customers in a two day Symposium once a year. At these events, ALMA, The International Loudspeaker Association, provides an opportunity for members to meet, share ideas, deal with common problems, and take the pulse of the industry.
- ALMA also provides additional educational opportunities as we also hold an international Symposium in China
- ALMA also provides additional networking opportunities for its members by having networking events at other industry trade shows.
- ALMA provides continuing education for loudspeaker engineers and designers through its programs of technical speakers and expert panelists. It is a venue for learning about new materials, new processes, and new designs.
- ALMA communicates news and information to the industry via its web site, e-newsletter, and alliances with industry publications.

ASK ABOUT MEMBERSHIP TODAY!

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Wikipedia: John Busenitz

Other committees may be developed as needed and approved by the Board.

SCHEDULE AT A GLANCE

Monday, January 5, 2009

8:00 a.m. – 4:00 p.m.

Training Program

(Separate Registration Required)

Loudspeakers & Rooms

- Dr. Floyd E. Toole

Tuesday, January 6, 2008

8:00 a.m. – 5:00 p.m. (half day also available)

Training Program

(Separate Registration Required)

Electroacoustic Measurement

- Christopher J. Struck

8:00 a.m. – 12:00 p.m.

Training Program

DSP – Paul Beckmann / Al Clarke

(Separate Registration Required)

9:00 a.m. – 12:00 p.m.

Exhibitor-set up

10:20 a.m. – 11:55 a.m.

Tutorial sessions

NWAA Labs - *Independent System*

Testing: How it can help you AND your customers

Menlo Scientific - *Mini and Microspeakers – A Walk on the Small Side*

12:00 p.m. – 6:00 p.m.

Exhibit Hall Open

12:00 p.m. – 1:00 p.m.

Lunch in the Exhibit Hall

1:00 - 3:00pm

Manufacturer Roundtable

3:00 - 4:00pm

Open Discussions - Consultants &

Manufacturing

4:15 p.m. – 5:15 p.m.

Tutorial sessions

Listen, Inc. - *Simplifying Loudspeaker*

Test using the New AmpConnect

5:00 p.m. – 6:30 p.m.

Welcome Reception - Exhibit Hall

7:00 p.m.

Members-only Dinner-Yolie's Brazilian

Steakhouse (address on page 17).

Transportation on own

Wednesday, January 7, 2008

8:00 a.m. – 9:00 a.m.

Breakfast in the Exhibit Hall

8:00 a.m. – 6:00 p.m.

Exhibit Hall Open

8:00 – 11:30 a.m.

Committee Meetings:

8:00 – Patents and Prior Art

8:30 – Soft Components Sub Committee

9:30 – AES/ALMA Liaison

10:00 – Standards

11:00 – Education

8:30 a.m. – 10:05 a.m.

Tutorial sessions

Earl Geddes: *Magnetics Design - Basics and Simple Analysis*

Victrex: *Loudspeaker Applications of APTIV™ Films*

11:30 a.m. – 12:00 p.m.

General Assembly Meeting

12:00 p.m. – 1:00 p.m.

Lunch in the Exhibit Hall

1:00 p.m. – 2:30 p.m.

Invited Papers

1:00 – Laurie Fincham & Steve Hutt:

Loudspeaker Production Variance

1:30 – Stefan Irrgang, Klippel GmbH

Production Noise in End of Line Testing

2:00 – Peter Larsen, Loudsoft

Woofer Design using non-linear BL(x) curves

2:30 - 3:30pm

Open Discussions - Test & Measurement & Design

3:30 p.m. – 5:00 p.m.

Panel Discussion

What loudspeaker specifications are relevant to perception?

5:00 p.m. – 6:30 p.m.

Networking Reception - Exhibit Hall

Detailed schedule with room assignments on pages 4-5!