ANSI STANDARDS FOR HEARING ASSISTIVE DEVICE SYSTEMS
ACKNOWLEDGEMENTS

- Phonak
- Frye Electronics
- Students
  - Caryn McLellan
  - Jennifer Alford
  - Sarah Wallace
  - Lauren Schaper
  - Amanda Loveless
  - Jennifer Stockwell
  - Sarah Cain
- KEMAR!!
OVERVIEW

- THE STORY
- AAA Guidelines for Fitting/Evaluation of FM
- ANSI Proposed Standard
  Specification of Hearing Assistance Devices/Systems
- New Measurements to possibly include in standards
THE STORY
Major Concerns:

**Neckloop Arrangements**

(Thibodeau, McCaffrey, & Abrahamson, 1988)

**DAI connections**

(Thibodeau, 1990)

**Low correlation with settings on FM body receivers and hearing loss**

(Thibodeau & Saucedo, 1990)

**FM Advantage re: Receiver Settings**

(Bondurant & Thibodeau, 2012)
These findings provided motivation to develop protocols that could be used by all professionals to evaluate Assistive Technology.

Great Disparity between the time we spent evaluating hearing aids versus assistive devices.

Eg. Child could have 3-4 appts to fit a personal hearing aid and then go to a school program and at one time, remove that aid and put on one that was NEVER tested electroacoustically much less in the real ear!
In 1980’s There was an ANSI working group for developing standards for the electroacoustic evaluation of assistive devices

In 1990’s Michael Wynne took over as chair and resurrected momentum

In 1997 Laura Wilber and Linda Thibodeau assumed roles as co-chairs
In 2009 Submitted the FIRST draft of HADS standard (at least 20 years of work) and received major feedback/comments but not insurmountable
THE STORY

Major delays...

Definition...ALD? HAD? HAT?

Scope...Personal? Wide Area?

Alerting?

Those that improve SNR?

Infrared? FM? AM?
In 2009, a presentation was made to ANSI S3.22 committee regarding the differences between HA’s and HAT’s. Starting place was definition: HADS as defined in HADS Standard: HADS are a group of instruments with diverse physical configurations that are intended to facilitate hearing by providing amplification of an acoustic signal and/or improving the SNR by means of a non-acoustic signal transmission method. They are packaged for individual coupling to one’s ear.
THE STORY

- HA defined in the HA Standard???

BUT WE DID INCLUDE A DEFINITION IN HADS STANDARD!

NOT SPECIFIED
A hearing aid is any wearable sound amplification device designed for, offered for the purpose of, or represented as aiding persons with hearing loss.

In general, hearing aids have internal microphones, amplifiers, and output transducers that are housed in the same physical unit.

Most Behind-the-ear (BTE) aids can be easily interfaced with a variety of HADS. However, in some instances, the microphones and/or output transducers may be housed externally.

Descriptions of the performance characteristics and the measurement of these characteristics is provided in ANSI S3.22 American National Standard Specification of Hearing Aid Characteristics and ANSI S3.42 American National Standard Testing Hearing Aids with a Broad-Band Noise Signal, and is not superseded by this standard.
### More Standards Comparisons

#### The Story

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>Describe definitions and measurements suitable for specification and evaluation of HADS</td>
<td>Specification of performance characteristics and their tolerances.</td>
</tr>
<tr>
<td>Components</td>
<td>Multiple Components including Transmitter, Receiver, and Coupling</td>
<td>Single Unit</td>
</tr>
<tr>
<td>Measurement Coupler</td>
<td>When existing couplers cannot be used (e.g. Earbud) manufacturer must specify coupler</td>
<td>Couplers specified for all styles of hearing aids</td>
</tr>
<tr>
<td>Stimuli</td>
<td>Complex and sinusoidal stimuli</td>
<td>Limited to sinusoidal stimuli</td>
</tr>
</tbody>
</table>
## More Standards Comparisons: The Story

<table>
<thead>
<tr>
<th>Comparison</th>
<th><strong>ANSI S3.47</strong> Specification of Hearing Assistance Devices/Systems</th>
<th><strong>ANSI S3.22</strong> Specification of Hearing Aid Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Control Settings</td>
<td>Volume control always full on because of complexity of multiple volume controls on components</td>
<td>Volume Control varies depending on measurement</td>
</tr>
<tr>
<td>Coupler Placement</td>
<td>Coupler may be placed outside the test chamber because of wireless transmission of signal; Need for specific instructions for placement of multiple components (e.g., Neckloop)</td>
<td>Coupler always placed inside the test chamber; Hearing aid always inside test chamber</td>
</tr>
<tr>
<td>Circuit Noise Measurement</td>
<td>Level of output in the coupler with no input when the volume is set to full on</td>
<td>“Equivalent” input noise determined by subtracting HFAG50 from output level in the coupler with no input</td>
</tr>
</tbody>
</table>
www.audiology.org
The Goals of fitting HAT are to:
1) provide audibility and intelligibility of speech that is commensurate with performance in ideal listening conditions,
2) maintain audibility of self and others, and
3) reduce the deleterious effects of distance, noise, and reverberation.
DEVICE OPTIONS
AAA FM GUIDELINES

Transmitters
 Receivers
 Batteries
FM TRANSMITTER OPTIONS

AAA FM GUIDELINES

- Microphone
- Channel
- Controls
- Programmable
- Batteries
- Indicator Lights
- Accessory Jacks
- Secondary Transmission
A Table is provided that includes the possible options for each category and the Pros and Cons.

Example: FM Microphones can vary by:
- Location: Head, Cheek, Lapel, Conference
- Type: Omni, Directional-Fixed, Directional-User Select
The FM system should provide at least 10 dB relative advantage over hearing aid only.

If the system typically has both the FM and HA microphones active, then verification should be performed in the FM+HA position.
Standardization of verification type, device and level in an abbreviated format

Type: E(electroacoustic), B(behavioral), R(real ear)

Device: HA, FM, HA/FM, FM/HA, CI

Inputs level: designated in dB$_{HL}$ or dB$_{SPL}$

When testing in noise, input level of main signal listed first, followed by level of noise

EFM/HA65$_{SPL}$

BHA50/50$_{HL}$
Assumptions re: ear-level FM systems

- Gain/Output characteristics of system are determined by hearing instrument settings
- Hearing instrument has been set for appropriate output and audibility with a variety of speech inputs
- Hearing instrument adjustments completed in coordination with dispensing audiologist
The use of a calibrated real speech signal is preferred over speech-weighted noise inputs.

Input levels to the FM mic are less than actual use inputs to assure that the FM response has the same compression characteristics as the HA response.

This is required by current test systems and hearing aid processing features.
Based on concept of Transparency: The condition in which equal inputs to the wireless and local microphones generate equal outputs from the hearing device.

Operational definition: Transparency in a personal wireless HAT system is attained when inputs of 65 dB_{SPL} to the FM and HA mics produce equal outputs from the HA.
CONFIRM HA RESPONSE FOR USER
- Evaluate HA with 65 dB SPL input

ATTACH FM RECEIVER

SET FM RECEIVER TO DEFAULT (E.G. +10)

FM MICROPHONE ON MUTE

COMPARE HA TO HA+FM FOR IMPEDANCE OR PROGRAMMING DIFFERENCES
- Evaluate HA/FM with 65 dB SPL input
Evaluate FM (in FM+HA mode) with 65 dB SPL input

- Use 3 freq. average @ 750, 1000 and 2000 Hz
- Subtract EHAFM65 avg from EFMAH65. If difference is >±2, change FM setting as appropriate and re-evaluate
- Perform listening check with simultaneous inputs to FM and HA. Adjust relationship, as needed
TEST ARRANGEMENT
AAA FM GUIDELINES

EHAFM65

EFMHA65
FM VERIFICATION
AAA FM GUIDELINES

Transparency
So we have a Guideline that for selecting, fitting, and verifying remote microphone technology but still need procedures for Electroacoustic Evaluation in standard protocol to compare to manufacturer specifications or to compare one device to another!
Working Group S3/WG 81, Specification of Hearing Assistance Devices/Systems, which assisted Accredited Standards Committee S3, Mechanical Vibration and Shock, in the development of this standard, had the following membership.

Linda Thibodeau and Laura Wilber, Co-Chairs

C. Palmer  B. Kruger  L. Revit
D. Preves  J. Smaldino  C. Sandrock
C. Compton  T. Cygnarowicz  B. Culpepper
J. K. Kane  I. Leonard  D. Lewis
B. Mills
This standard defines various types of HADS and describes procedures for measuring their performance characteristics.

These procedures are useful for comparing the performance characteristics among various HADS.

This standard addresses the measurement of the output characteristics of HADS regardless of the method of transmission.

Whenever the device/system is capable of transmitting signals using two or more transmission methods, this standard requires that the output of the device/system be measured using each transmission method.
This document describes measurements of output characteristics when a remote microphone arrangement is used.

There are potentially multiple components to HADS (e.g. FM transmitter delivering to an FM Receiver connected to a neckloop transmitting to a t-coil in a hearing aid), and several employ output transducers that cannot be measured with standard couplers,
The electroacoustic characteristics described within the standard include:

- family of response curves (50- to 90-dB SPL input in 10 dB increments)
- output sound pressure level for 90-dB SPL input
- high frequency average output sound pressure level for 90-dB SPL input
- high frequency average output sound pressure level for 50-dB SPL input
- frequency range
The electroacoustic characteristics described within the standard include:

- total harmonic distortion
- noise level with no input
- input-output characteristics
- dynamic automatic gain control (AGC) characteristics
- gain control linearity
- current drain
- immunity to electromagnetic interference
The document does NOT address measurement of:

- hearing aids or personal sound amplifiers which can be evaluated according to procedures described in ANSI S3.22.
- large-area assistive listening systems that are not packaged for individual coupling to the listener’s ear, telephone amplifiers, and alerting devices.
- implants and bone conduction devices.
RADIO SHACK PRODUCTS
WHAT STANDARD ADDRESSES THESE?
HADS S fall into one of the following categories:

1) The output of the devices/systems can be measured by standardized or existing couplers.

2) The output of the devices/systems cannot be measured with existing standardized couplers but delivers an acoustic signal to the ear, eg. earbuds.

3) The devices/systems do not deliver an acoustic signal to the ear but interface with other devices/systems that do, such as those that use direct input or electromagnetic (induction) coupling to hearing aids.
FIG. 2. Test setup for evaluation of HADS with direct audio input.
FIG. 2. Test setup for evaluation of HADS with direct audio input.
TEST ARRANGEMENT FOR NECKLOOP EVALUATION
ANSI SPECIFICATION OF HADS
TEST ARRANGEMENT FOR NECKLOOP EVALUATION
ANSI SPECIFICATION OF HADS
TEST ARRANGEMENT FOR NECKLOOP EVALUATION

ANSI SPECIFICATION OF HADS

Mic

Transmitter

Sound Chamber

Analyzer

2 cm³ Coupler

Final Component: Hearing Aid

Receiver
NEW MEASUREMENTS?

- Directionality
- Adaptive FM Features
- Streamers
Polar plot analysis with 60 dBSPL composite signal to the mic

- HA Directionality
- FM Directionality
Polar plot analysis with 60 dBSPL composite signal to the mic for NIOS H20 with MLxi and Inspiro.

- Directionality for HA With MLxi.
- FM Mic in Non-Verification mode.
- FM Mic in Verification mode.
AAA Guidelines address the selection, fitting, and verification of FM Systems.

ANSI Specifications for HADS address specific measurements that reflect the acoustic characteristics of the device to facilitate comparison across manufacturers and determine if a device is meeting specifications.

Technology is changing so fast, the Volunteers who work on these documents are constantly revising.

Professionals need to advocate for electroacoustic evaluation of all devices including those NOT sold in professional settings (i.e., personal sound amplifiers).
THANK YOU FOR LISTENING TO THE STORY!

Story time is over!