

ANSI STANDARDS FOR HEARING ASSISTIVE DEVICE SYSTEMS

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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



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)

THE STORY

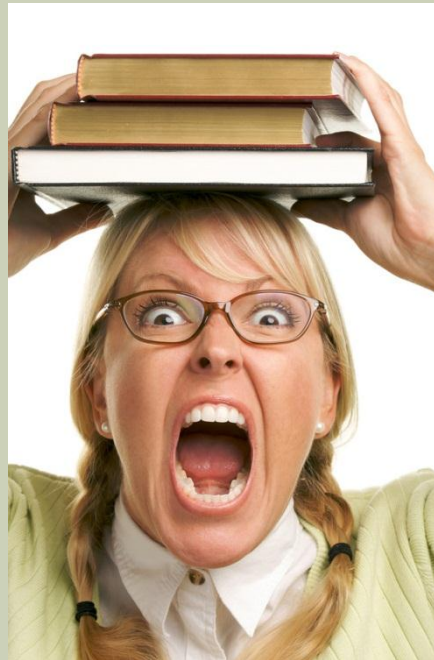
- These findings provided motivation to develop protocols that could be used by all professionals to evaluate Assistive Technology
- Great Disparity between the time we spent evaluating hearing aids versus assistive devices
 - Eg. Child could have 3-4 appts to fit a personal hearing aid and then go to 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!

THE STORY

- 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?



THE STORY

- 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:

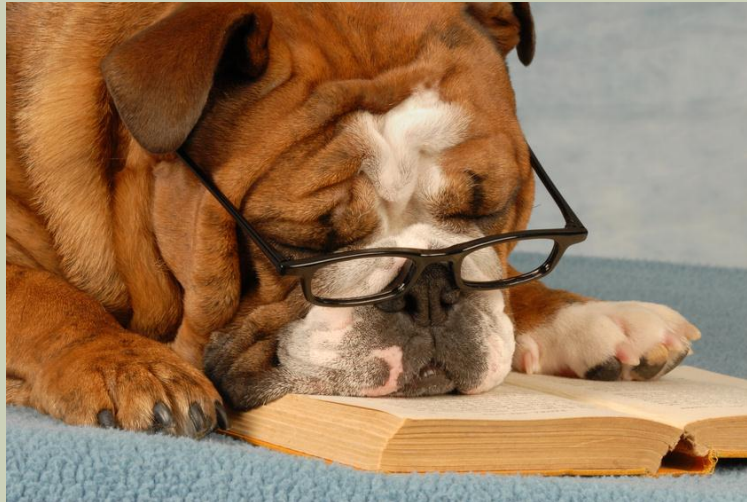
HADS are a group of instruments with diverse physical configurations that are intended to facilitate hearing by providing amplification of an acoustic signal and/or improving the SNR by means of a non-acoustic signal transmission method. They are packaged for individual coupling to one's ear.

THE STORY

- HA defined in the HA Standard???

BUT WE DID INCLUDE A DEFINITION IN HADS STANDARD!

NOT SPECIFIED



HA DEFINITION IN HADS STANDARD

Hearing aid

- 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

Comparison	ANSI S3.47 Specification of Hearing Assistance Devices/Systems	ANSI S3.22 Specification of Hearing Aid Characteristics
Purpose	Describe definitions and measurements suitable for specification and evaluation of HADS	Specification of performance characteristics and their tolerances.
Components	Multiple Components including Transmitter, Receiver, and Coupling	Single Unit
Measurement Coupler	When existing couplers cannot be used (eg. <u>Earbud</u>) manufacturer must specify coupler	Couplers specified for all styles of hearing aids
Stimuli	Complex and sinusoidal stimuli	Limited to sinusoidal stimuli

MORE STANDARDS COMPARISONS

THE STORY

Comparison	ANSI S3.47 Specification of Hearing Assistance Devices/Systems	ANSI S3.22 Specification of Hearing Aid Characteristics
Volume Control Settings	Volume control always full on because of complexity of multiple volume controls on components	Volume Control varies depending on measurement
Coupler Placement	Coupler may be placed outside the test chamber because of wireless transmission of signal; Need for specific instructions for placement of multiple components (eg. Neckloop)	Coupler always placed inside the test chamber; Hearing aid always inside test chamber
Circuit Noise Measurement	Level of output in the coupler with no input when the volume is set to full on	“Equivalent” input noise determined by subtracting HFAG50 from output level in the coupler with no input

AAA GUIDELINES

- **Clinical Practice Guidelines: Remote Microphone Hearing Assistance Technologies for Children and Youth Birth-21 Years (2008)**
www.audiology.org

FITTING GOALS AAA FM GUIDELINES

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

FM TRANSMITTER OPTIONS

AAA FM GUIDELINES

- 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

VERIFICATION PRIORITIES

AAA FM GUIDELINES

- 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

FM TERMINOLOGY & SHORTHAND

AAA FM GUIDELINES

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

EFM/HA65_{SPL}

BHA50/50_{HL}

ELECTROACOUSTIC VERIFICATION

AAA FM GUIDELINES

- **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

ELECTROACOUSTIC VERIFICATION AAA FM GUIDELINES

- 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

PRINCIPLES OF ELECTROACOUSTIC VERIFICATION

- **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

BASIC VERIFICATION STEPS

AAA FM GUIDELINES

- 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

BASIC VERIFICATION STEPS

AAA FM GUIDELINES

- Evaluate FM (in FM+HA mode) with 65 dB SPL input
- Use 3 freq. average @ 750, 1000 and 2000 Hz
- Subtract EHA FM65 avg from EFMAH65. If difference is $> \pm 2$, 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

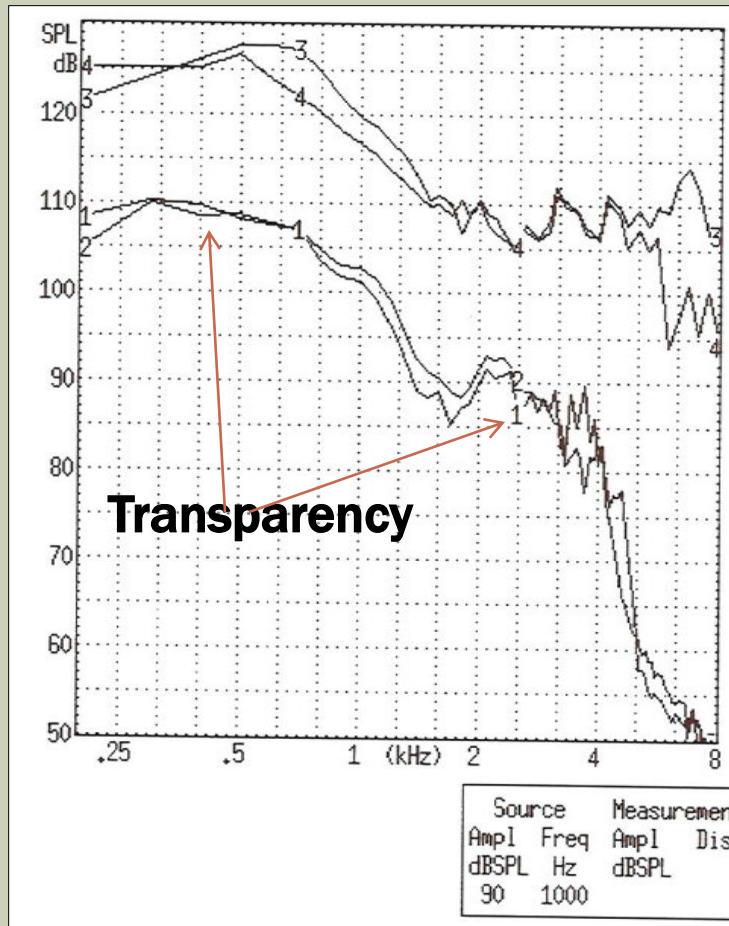


EHA FM65



EFM HA65

FM VERIFICATION AAA FM GUIDELINES

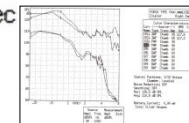


FONIX TYPE 7000 ANALYZER
Coupler Right Ear

Curve Characteristics					
Curv	←Source→		RMS	Cor	NR
Name	Type	Trans	Ampl	Out	
CR14	DWP	Chamb	65	117.6	4X
CR24	DWP	Chamb	65	117.2	4X
CR3E	PMP	Chamb	90		Off
CR3E	PMP	Chamb	90		Off
CR5	DWP	Chamb	60		4X
CR6	DWP	Chamb	60		4X
CR7	DWP	Chamb	60		4X
CR8	DWP	Chamb	60		4X
CR9	DWP	Chamb	60		4X
CRX	DWP	Chamb	60		4X

Source: Puretone, 1/12 Octave
Chamber, Leveled
Noise Reduction: Off
Smoothing: Off
Max: 126.5 dB SPL
Avg: 110.5 dB SPL

Battery Current: 0.00 mA
Size: Silver Unspec



LET'S GET BACK TO THE STORY RE: ANSI STANDARD



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 MEMBERS ANSI SPECIFICATION OF HADS

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
D. Preves
C. Compton
J. K. Kane
B. Mills

B. Kruger
J. Smaldino
T. Cygnarowicz
I. Leonard

L. Revit
C. Sandrock
B. Culpepper
D. Lewis

SCOPE

ANSI SPECIFICATION OF HADS

- 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.

SCOPE

ANSI SPECIFICATION OF HADS

- 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,

MEASUREMENTS

ANSI SPECIFICATION OF HADS

- 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

MEASUREMENTS

ANSI SPECIFICATION OF HADS

- 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

EXCLUSIONS

ANSI SPECIFICATION OF HADS

- 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?

The screenshot shows the RadioShack website interface. At the top, there is a navigation bar with the RadioShack logo, customer service contact info (24/7 Customer Service, 800-843-7422), a store selector, a language option (Español), and account links (Store Finder, My Account, Shopping Cart with 0 items for \$0.00). Below the navigation is a search bar containing the text "personal sound amplifier". A horizontal menu below the search bar lists categories: CELL PHONES & ACCESSORIES, ELECTRONICS & ACCESSORIES, HOBBY & DO-IT-YOURSELF, BATTERIES & POWER, and SHOP ALL PRODUCTS. Below this are six circular icons with labels: CHECK YOUR UPGRADE, TRADE & SAVE, DO-IT-YOURSELF, TALK TO AN EXPERT, FIND YOUR STORE, and FIND A BATTERY. A prominent red banner across the middle of the page reads "GET \$10 BACK FOR EVERY \$50 YOU SPEND*" with a "SHOP NOW" button. Below the banner, the "Music & Audio" section is active, showing two product listings. The first listing is for the "Loud 'N Clear™ Personal Sound Amplifier" (Model: 63-238 | Catalog #: 63-238) priced at \$9.99 with a 4-star rating. The second listing is for the "RCA® Symphonix™ Personal Sound Amplifier" (Model: RPSA10 | Catalog #: 63-423) priced at \$299.99 with a 4.5-star rating. Both listings include product images, descriptions, and "ADD TO CART" buttons. A sidebar on the left contains the text "And also look in... Product Manuals (203) Or try our Battery Finder".

24/7 Customer Service
(800) 843-7422

My Store:
(Select Your Store)

Español

Store Finder | My Account | 0 items \$0.00

Deals | Services | Weekly Ad

personal sound amplifier

RadioShack

CELL PHONES & ACCESSORIES | ELECTRONICS & ACCESSORIES | HOBBY & DO-IT-YOURSELF | BATTERIES & POWER | SHOP ALL PRODUCTS

CHECK YOUR UPGRADE > | TRADE & SAVE > | DO-IT-YOURSELF > | TALK TO AN EXPERT > | FIND YOUR STORE > | FIND A BATTERY >

GET \$10 BACK FOR EVERY \$50 YOU SPEND* **SHOP NOW**

Music & Audio (1)

And also look in...
Product Manuals (203)
Or try our **Battery Finder**

Model: 63-238 | Catalog #: 63-238

Loud 'N Clear™ Personal Sound Amplifier

\$9.99

★★★★☆

Never miss another word at lectures, movies, shows or even church with Loud 'N Clear.

Free Ground Shipping on orders over \$50. [Details](#)

AVAILABILITY:
● **ONLINE:** In-Stock
Usually ships in 1 - 2 business days
● **IN-STORE:**
[Find it in your store](#)

+ ADD TO CART

Model: RPSA10 | Catalog #: 63-423

RCA® Symphonix™ Personal Sound Amplifier

\$299.99

★★★★☆

The RCA Symphonix Personal Sound Amplifier is designed to help you hear better in all kinds of situa...
[See the Full Product Details](#)

Free Ground Shipping on orders over \$50. [Details](#)

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UT DALLAS
CALLIER CENTER

HADS CATEGORIES

ANSI SPECIFICATION OF HADS

HADS 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.

TEST ARRANGEMENT FOR DAI EVALUATION ANSI SPECIFICATION OF HADS

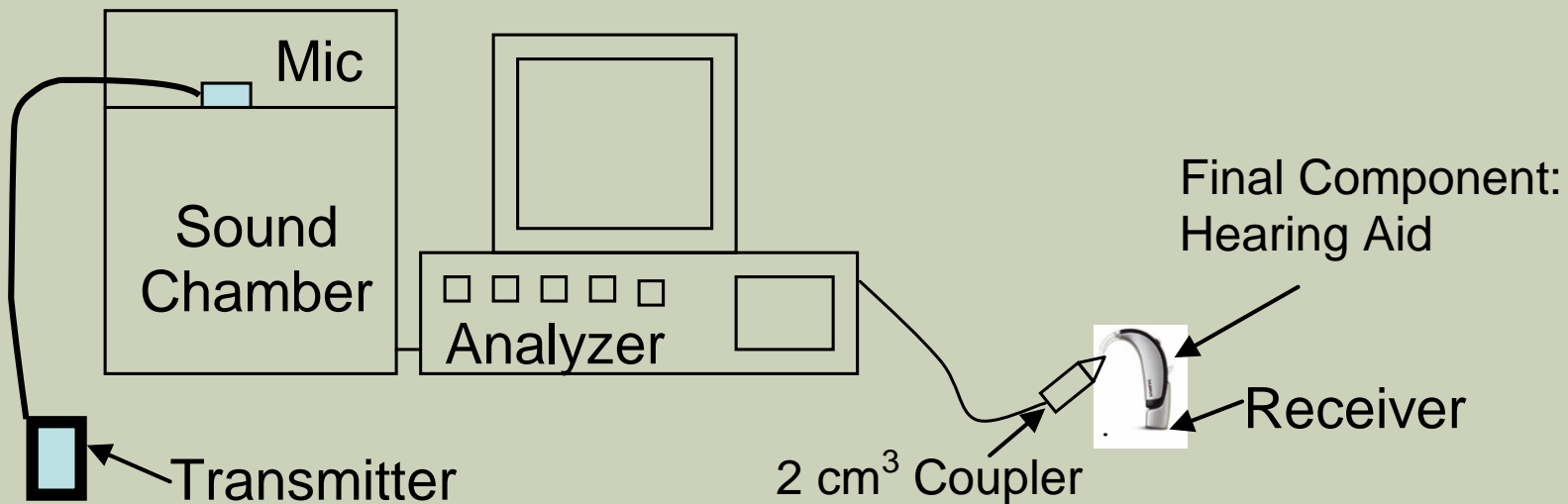


FIG. 2. Test setup for evaluation of HADS with direct audio input.

TEST ARRANGEMENT FOR DIRECT AUDIO INPUT EVALUATION ANSI SPECIFICATION OF HADS

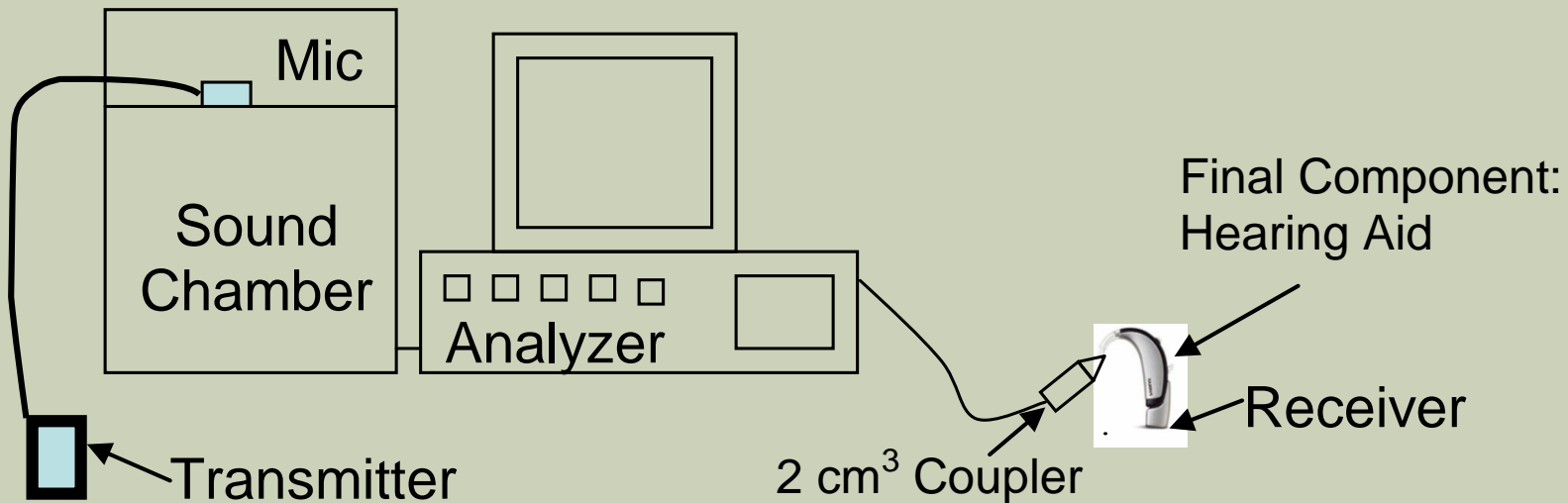


FIG. 2. Test setup for evaluation of HADS with direct audio input.

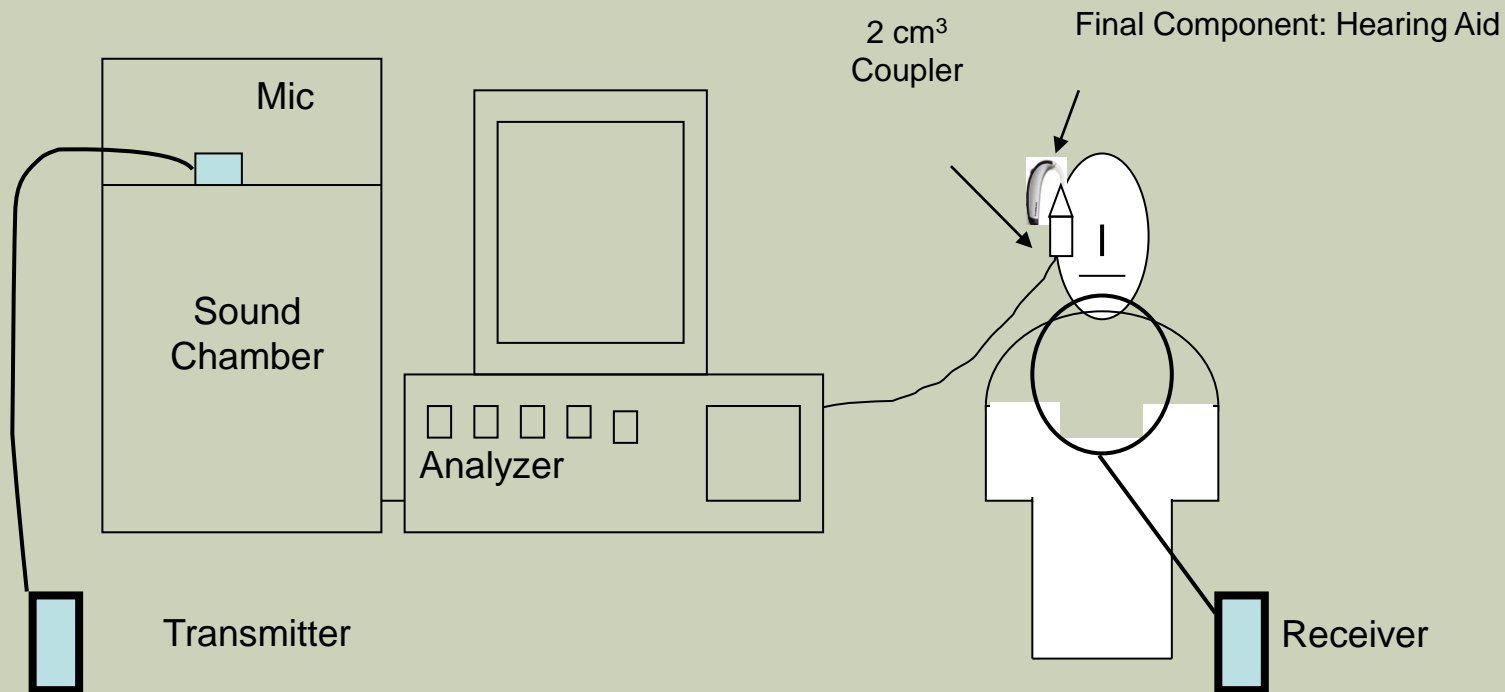
TEST ARRANGEMENT FOR NECKLOOP EVALUATION ANSI SPECIFICATION OF HADS



TEST ARRANGEMENT FOR NECKLOOP EVALUATION ANSI SPECIFICATION OF HADS



TEST ARRANGEMENT FOR NECKLOOP EVALUATION ANSI SPECIFICATION OF HADS



NEW MEASUREMENTS?

- Directionality 
- Adaptive FM Features
- Streamers

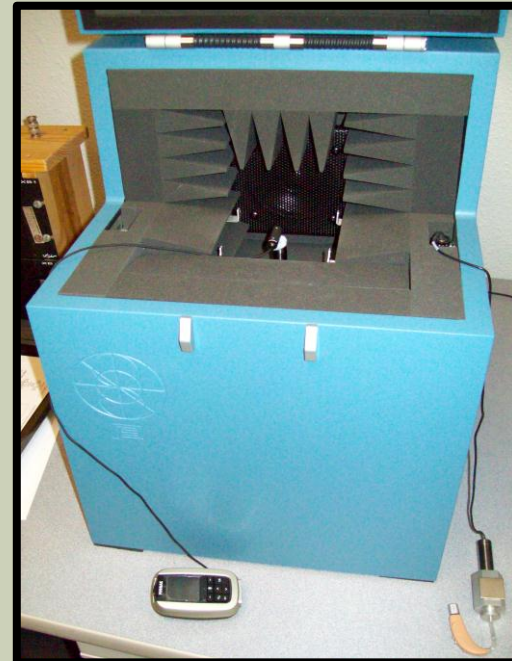
DIRECTIONALITY EFFECTS

(ALFORD AND THIBODEAU, 2012)

- Polar plot analysis with 60 dB SPL composite signal to the mic



HA Directionality

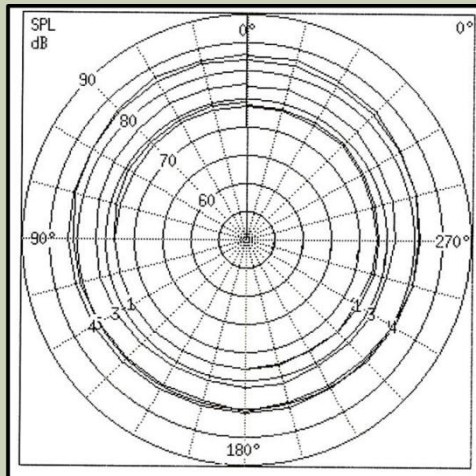


FM Directionality

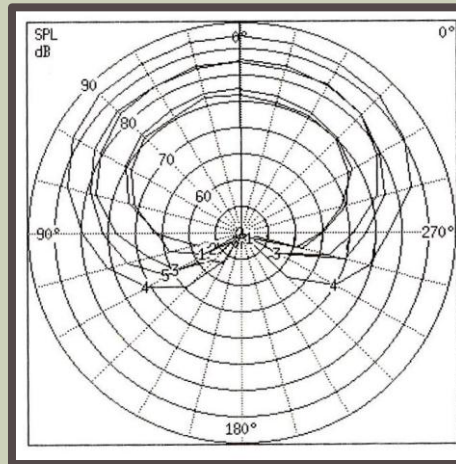
DIRECTIONALITY EFFECTS

(ALFORD AND THIBODEAU, 2012)

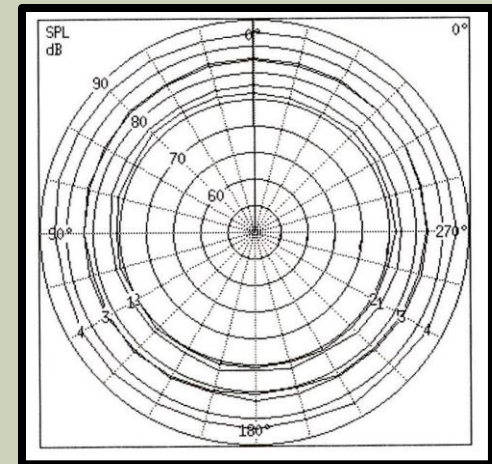
- Polar plot analysis with 60 dB SPL composite signal to the mic for NIOS H20 with MLxi and Inspiro



Directionality for HA
With MLxi.



FM Mic in Non-
Verification mode.



FM Mic in
Verification mode.

SUMMARY

- 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 (ie personal sound amplifier)

THANK YOU FOR LISTENING TO
THE STORY!

