Welcome!

Judy Grobstein, AuD-FAAA, MACAud
Manager of Education and Audiology

Best option for audio is to call in using
Phone Number: 02 8518 1923 Access Code: 809 815 825

For technical questions or log-in information please contact Dan Towns
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Webinar Experience

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Please be sure to keep microphones muted

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Endorsed Session

This Session is endorsed for ACAud, AudA and HAASA points

You must stay logged on for the full session

AudA members must complete a 10 questions quiz with a passing score of 70% as well as your CPD Reflections and Evaluations

ACAud, HAASA and NZAS members must complete the quiz to receive full points.

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Learning Objectives

Identify how to choose the appropriate acoustic options based on the patient's audiogram

Identify the different types of feedback and describe the approaches used to manage it in today's hearing aids

List two ways to differentiate a malfunctioning microphone from a malfunctioning receiver

Back to the Basics

Judy Grobstein, AuD-FAAA, MACAud
Manager of Education and Audiology

Agenda

- Acoustic Options
- Feedback
- Component Troubleshooting

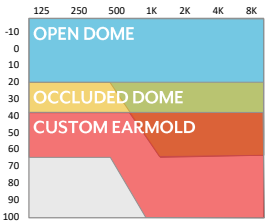
Acoustic Options

Optimizing the Patient Journey

Choosing the correct acoustic options is an important tool for optimizing the patient journey with amplification

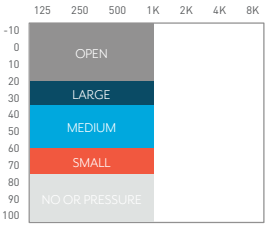
Audiometric Factors

Acoustic Coupling Guidelines



Audiometric Factors

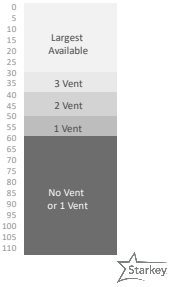
Venting Guidelines



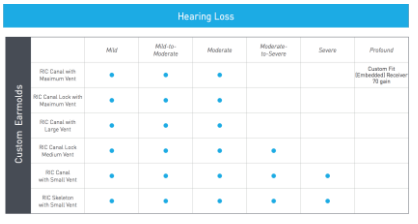
Audiometric Factors

Venting Guidelines

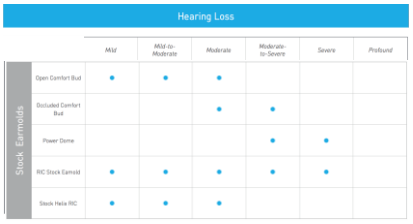
Vent
750 Hz

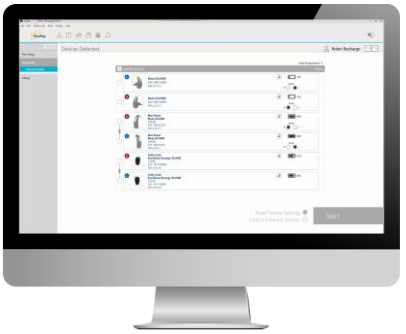


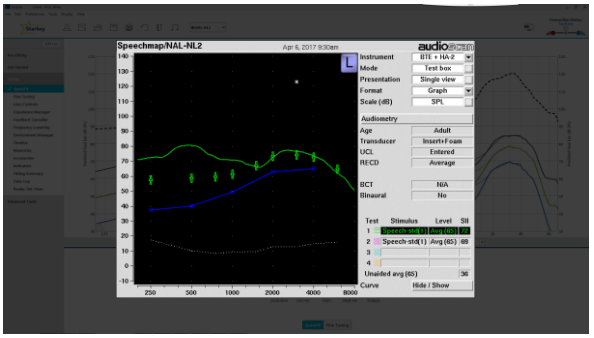
RIC Custom Earmolds

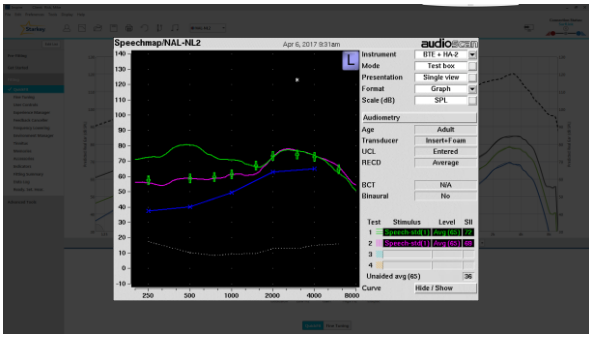


RIC Stock Earmolds





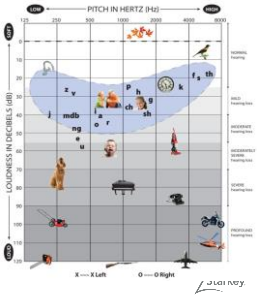




Hearing Aid Gain

The difference between the input level and the output (in dB SPL)

"Amplification that allows a person with hearing loss to hear, communicate, and participate more fully in daily activities."



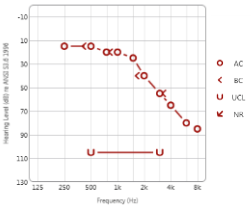
Choosing the Right Matrix

2000 Hz

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110

40 gain | 50 gain | 60 gain | 70/71 gain | 80 gain

Power Requirements



- Poor high frequency thresholds should NOT be part of the equation
- Don't want high frequency gain to overpower low frequencies
- Distortion and impact on sound quality

eSTAT: Starkey's Proprietary Fitting Formula

Emphasizes audibility for speech understanding

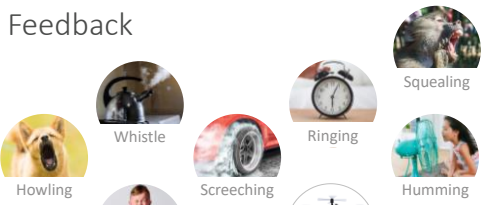
Developed for Starkey's proprietary compression architecture

Optimizes response modeling regardless of hearing aid style

Optimizes vent hearing aid interaction

Feedback Management in Hearing Aid Technology

Feedback



Feedback

ACOUSTIC	Occurs when the output of the receiver leaks out of the ear canal, enters the microphone and is reamplified
MECHANICAL	Occurs when physical vibrations of the receiver diaphragm are transmitted back to the microphone diaphragm through contact with the hearing aid casing
ELECTRONIC	Occurs when there is a malfunction in the device's circuitry

Mechanical Feedback

Customs

- More susceptible
- Receiver and microphone are in the same housing
- Vibrational energy can lead to feedback

BTEs and RICs

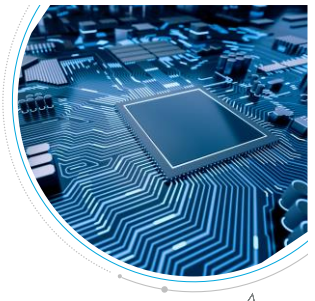
- Less susceptible
- Greater physical separation between components
- RIC receiver is moved out of the instrument case

Electronic Feedback

Malfunction in the components of the device

Solution involves opening the case and determining the source of the problem and possible replacement of the electronics of the device

Requires attention from the manufacturer



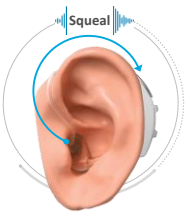
Testing for Internal Feedback

Seal the receiver off at the canal tip and hold the device up to the ear to listen - any whistling will verify and confirm internal feedback.

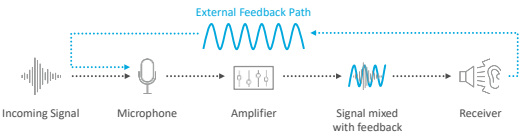
- Fingertip
- Putty
- Listening stethoscope

Acoustic Feedback

- Sound wave from the receiver leaks back to the microphone
- Amplified signal –> reamplified
- Undesired oscillations in the hearing aid create instability
- Instability can lead to an audible sound that is usually unpleasant



Acoustic Feedback



Factors Influencing the Feedback Path

- Venting
- Loose fit / Poor coupling
- Cracked or damaged earmold or shell
- Improper alignment of the receiver
- Hearing aid gain

Factors Influencing the Feedback Path

- Cerumen
- Hats, Scarves and other Head Coverings
- Jaw and head movements
- Hugs
- Coughing, chewing, sneezing, yawning, talking
- Positioning an object near the ear
- Hand – inserting/removing the hearing aids

Effects of Feedback

- Loudness Discomfort
- Sound Annoyance
- Distortion / Reduced Sound Quality
- Reduced Speech Understanding
- Reduced Perceived Benefit of Amplification
- Hearing aids don't work well - Stigma
- Embarrassing
- Hearing aid rejection

> "The most common reasons people stop wearing or return their hearing aids are because the device is physically uncomfortable or does not perform as well as expected…
>
> Performance falls short of expectations when there is too much background noise, too much feedback and/or poor sound quality. "

MarkeTrak 9

Background Noise **21%**

Feedback **17%**

Sound Quality **16%**

"Top Reasons No Longer Have Hearing Aid"

Background Noise **12%**

Feedback **14%**

Sound Quality **10%**

MarkeTrak 10

Feedback Management

Goals of Feedback Management

- Better physical fit and comfort
- Make soft sounds more audible
- Increase speech understanding
- Improve sound quality
- Better performance in all environments

Managing Feedback

Acoustic Adjustments

Gain Reduction

Feedback Cancellation

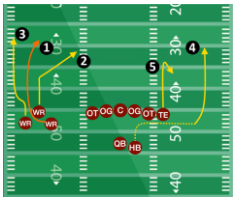
Acoustic Adjustments

Reduce the leakage of sound

- Vent Diameter
- Diameter of 1st Bend
- Tubing Size
- Dome Size
- Custom Earmolds
- Stock Earmolds

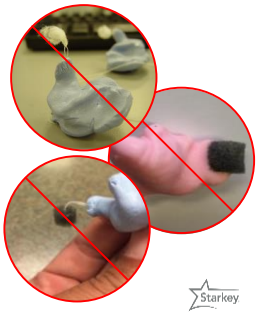
The Best Defense is a Good Offense

- Ear Impressions
- Coupling
- Alignment
- Venting

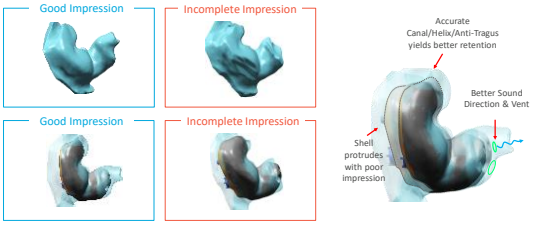


Good Ear Impressions

- Use cotton otoblocks
- Capture the full concha bowl and helix for proper alignment in the ear
- Deep impression for CIC and IIC orders
- Send new impressions with each order



Complete vs Incomplete Impressions

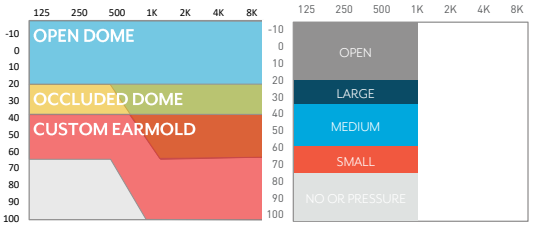


Earmolds/Domes

When to replace:

- Weight changes
- Size changes (children/surgery)
- Hearing threshold changes
- Ear canal tissue stretching
- Damage
- Loose Fit
- Feedback

Venting: Remember your cut off



Gain Reduction

- Equally over all frequencies
- For the lowest input level (highest gain re: WDRC)
- In critical frequency regions where feedback is expected to occur
  - Notch filtering - gain is reduced in narrow frequency bands around critical frequencies

Feedback Cancellation

The premise behind feedback-cancellation algorithms is similar to that of noise cancelling headphones.

It creates a copy of the feedback component and adds it out of phase to the input signal.

Hearing aid manufacturers have their own proprietary algorithms.

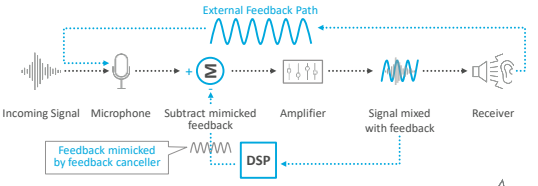
Starkey · WIDEX · PHONAK · signia · ReSound · oticon

Goals of Feedback Cancellation

- Achieve as much gain as possible over a wide frequency range while eliminating feedback
- Preserve audibility, speech intelligibility, sound quality, and comfort
- Do not allow processing artifacts that could degrade sound quality
- Low susceptibility to tonal signals/entrainment
- Quickly adjust to feedback path changes

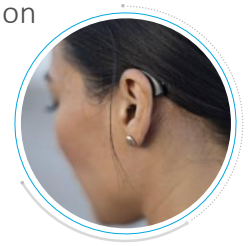
Feedback Cancellation

1 Feedback path is modeled mathematically 2 Subtracted from the microphone signal 3 Feedback is canceled



Feedback Cancellation

- No gain reduction
- Can improve the stability of the hearing aid and provide additional gain
  Compared to an instrument setting that does not use feedback cancellation
- Effective with open fits and large vents
  - Static and Adaptive Filters
  - Artifacts
  - Entrainment



Static Filter

Static Feedback Cancellation Filter

- Single filter applied
- Based on area where the highest feedback potential exists
- Useful for stable environments where the feedback path won't change
- Ideal for eliminating entrainment
- No artifact (warble) from output phase modulation

Adaptive Filter

Adaptive Feedback Cancellation Filter

- Filter is always changing to address changes to the feedback path
- Feedback canceller settings regulate the speed of adaptation to the new signal
- Balancing act re: speed of filter changes
- Faster helpful to address changing path but may yield artifacts

Entrainment

When a feedback canceller mistakenly attempts to cancel a tonal input or the addition of a tone to the original source by the hearing aid itself.

May report hearing

- The additional tone
- Feedback after the original sound has stopped
- Modulation-type distortion of the sound
- Distortion

Entrainment artifacts

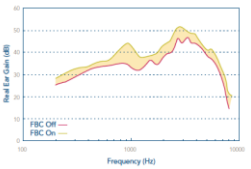
Can be eliminated by using a non-adaptive approach to feedback cancellation / static filter

FBCX Initialization

- Broadband noise with a known spectrum (white noise) played through the hearing aid
- Creates a buzzing sound
- Frequency response of the signal at the source is compared to the response at the microphone of the hearing aid
- Measures potential feedback paths
- Frequency regions in which feedback is most likely to pose a problem are identified
- Accounts for individual anatomy and fitting
- Performed in a quiet environment

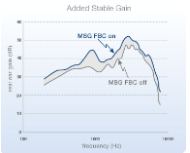
Maximum Stable Gain (MSG)

- Highest amount of gain that can be provided without risk of audible feedback or degraded sound quality due to feedback oscillation
  (Johnson et al., 2007; Ricketts et al., 2008)
- Varies as a function of frequency
- Should be greater with FBC enabled vs. disabled



Added Stable Gain (ASG)

- Difference in MSG with FBCX algorithm OFF vs. ON
- Additional gain available when the hearing aid's feedback cancellation algorithm is active
- Varies across manufacturers



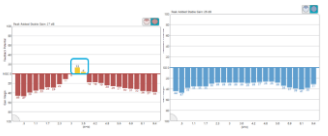
Starkey Feedback Cancellation

Gain Margins

Active in up to 24 bands

Up to 25dB addes stable gain (open fit)

No gain cap or reduction



Gain Margin: Number of dB programmed gain is below maximum stable gain

Feedback Cancellation

Starkey has three feedback canceller settings

Adaptive, Low Sensitivity

Adaptive, High Sensitivity

Off

This allows the professional to optimize performance and sound quality for each patient per memory

FBCX Initialization

- New fittings
- Wearer reports feedback artifacts
- Changes to coupling
- Change to venting
- Re-fitting following hearing aid repair

Fun Fact

"I Feel Fine" starts with a percussive feedback note

John Lennon's guitar was resting against Paul McCartney's bass amp when McCartney plucked a string

Lennon's semi-acoustic guitar picked up the amplified sound

First use of feedback on a rock record

Organic Component Troubleshooting

Benefits of Keeping It "Organic"

- Instills patient's trust and confidence in you
- Reduces "down time" for the patient
- Reduces number of office visits (frees up chair time)
- Reduces clinic costs
- Reduces patient costs
- Increased patient satisfaction = Increased word of mouth

Invest in Your Hearing Aid Clinic

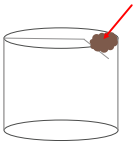
Hearing Aid Clinic Supplies

- ☐ Grinder
- ☐ Buffer pads/buffing wax
- ☐ Grinder wheels
- ☐ Probing tools
- ☐ Suction
- ☐ UV light/materials
- ☐ Putty
- ☐ Hydrogen Peroxide
- ☐ Reamer kit
- ☐ Tubing Assortment
- ☐ Listening mold
- ☐ Spare otoscope
- ☐ Scissors
- ☐ Tweezers
- ☐ Permanent glue
- ☐ Electric contact cleaner
- ☐ Sanitizing wipes
- ☐ Canned air
- ☐ Tubing cement
- ☐ Earmold blower
- ☐ Tube puller
- ☐ Tubing expander
- ☐ Earhooks
- ☐ Receivers
- ☐ Safety goggles
- ☐ Medical grade gloves
- ☐ Grinding stones
- ☐ Carbide cutters
- ☐ Needle nose pliers
- ☐ Contact Cleaner
- ☐ Nelson tools
- ☐ Voltage meter

*Not meant to be an exhaustive list

Hearing Aid Clinic Supplies

Hearing Aid Clinic Supplies



Ask the Right Questions

- What is the complaint?
- When did it happen?
- Where do you store the hearing aids?
- Was it a sudden change or gradual?
- What were they doing when this happened?
- How often does it happen?
- Where are they when this happens?

Examine the Hearing Aid

- ☐ **Always** check battery first
- ☐ Is the microphone/cover clear of debris
- ☐ Is the receiver clear of debris
- ☐ How does the hearing aid **sound**

How Does the Hearing Aid **Sound**?

- Is the hearing aid dead?
- Is there feedback but no amplification?
- Is there circuit noise but no amplification?
- Is the hearing aid weak?
- Is the sound distorted?
- Is there intermittency?
- Is there feedback?

Is the Hearing Aid "Dead"?

- Check the battery
  Dead battery is the #1 cause of hearing aid complaints
- Listening for feedback is a good indicator that your battery is ok
- Is it the microphone?
- Is it the receiver?
- Did you squeeze the casing?

Is it the Microphone?

If you can hear feedback or the indicator tones, the receiver is still good and it is likely the microphone

- Remove microphone cover – listen again
- Use otoscope to examine microphone
- If necessary, use chemical solvent (alcohol)
- Use suction and needle to probe microphone in an effort to remove debris
- Sometimes lightly scraping the surface of the microphone will remove debris
- If unsuccessful, send for repair

Is There Circuit Noise But No Amplification?

- Check the battery
- Likely a microphone issue – if you hear circuit noise, the receiver is still good
- Remove microphone cover - listen again
- Use otoscope to examine microphone

Is the Hearing Aid Weak?

- Check the battery
- Likely a receiver issue
- Remove wax guard *(if applicable)*
- Listen to hearing aid
- Probe with needle in an effort to remove debris
- Use solvent (alcohol) and suction as necessary
- If applicable, change receiver

Is the Sound Distorted?

- Likely caused by moisture in the hearing aid
- Might be caused by debris lying on the diaphragm of either microphone or receiver
- Check for moisture in the battery housing
- Use gentle suction on both microphone and receiver to remove moisture
- If applicable, check for moisture in the tubing
- Use hypodermic needle to gently scrape the diaphragm of both the microphone and receiver
- Check to be sure the vent is not plugged with debris

Is the Hearing Aid Intermittent?

- Check the battery
- Check the battery contacts to be sure they put sufficient pressure on the battery
- Check the battery door to be sure it has sufficient retention
- Listen for a short in the wiring while squeezing the casing of the hearing aid
- If applicable, "wiggle" the base of the receiver while listening for a short
- If applicable, be sure the receiver is securely plugged in

Using Modification to Increase Patient Satisfaction

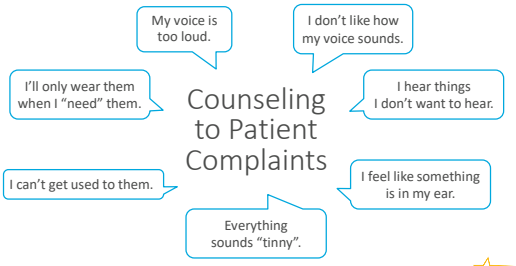
- Venting to address feedback or occlusion
- Dampers to adjust frequency response
- Horns to adjust frequency response
- Modifying the shell to address occlusion, discomfort or feedback
- Earbuds to adjust frequency response

Modifying the Shell to Address Occlusion, Discomfort or Feedback

- Occlusion can be addressed by shortening or tapering canal portion of hearing aid
- Discomfort can be addressed by locating where the ear is sore and grinding/buffing that portion of the hearing aid
- Feedback caused by slit-leak can be addressed by putting a UV retention ring around the base of the faceplate

Modifying the Shell to Address Occlusion, Discomfort or Feedback

- Lucite is easiest to modify
- Silicone is the most difficult to modify
- The same principles as mentioned above apply to earmolds



Learn More

Back to the Basics
Tuesday 18 February 2020

Mastering Advanced Features
Tuesday 10 March 2020

Bringing it all Together with Inspire 2019.1 Software
Tuesday 7 April 2020

All courses 1:00pm to 2:00pm Sydney Time

Endorsed for Live and Recorded sessions

Save the date now so you don't miss this must-attend launch event ahead of the Audiology Australia 2020 Conference in Perth.

Your Starkey team

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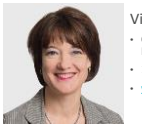

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Questions?

Starkey Hearing Technologies

Endorsement Points

ACAud Endorsed: 202004 (2 CEP points)

AudA Endorsed: CPD1920 047 (Category 1.2) (1 CPD point)

HAASA Endorsed: CPED2018-2020 (2020-003) (1.5 CPED points)

Thank You!

Starkey Hearing Technologies

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