RECD-Measurements with Connexx 6.3 and Unity 2

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Why miss a decibel of vroom vroom?
Overview

- Why measure RECD?
- RECD with Unity 2
- RECD with Unity via Connexx ClinicalFit
- RECD in Unity: Extended Options
- RECD: Possible Pitfalls
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Why measure RECD?

Anatomical terms

- *Every ear canal has an individual shape and size!*  
- Coupler or ear simulator can only provide an estimate / approximation of the residual ear canal volume and resulting acoustics at the eardrum  
- Esp. in children, auricle and ear canal are smaller, more straight and more narrow than in adults  
- *Resonance peaks are shifted towards higher frequencies*
Why measure RECD?

resonance peaks in ear canal shifted to higher frequencies!

REUG according to age

RECD according to age

Why measure RECD?
Why measure RECD?

This might contribute to a higher sound level at the eardrum of more than 20 dB! Danger of over-amplification!
Why measure RECD?

Measuring options for verification under real-ear (In-Situ) conditions

- recommended stimuli for NAL-NL1 and DSL:
  - ISTS (speech signal)
  - ILTASS (un-modulated)
  - Icra1 (un-modulated)
  - Icra7 (modulated)

- RECD measurement
- In-Situ measurement
- OEG measurement
- Coupler measurement
- REIG measurement
Why measure RECD?

Measuring options for verification under real-ear (In-Situ) conditions

recommended stimuli for NAL-NL1 and DSL:
 ISTS (speech signal), ILTASS (un-modulated), lcra1 (un-modulated), lcra7 (modulated)

- RECD measurement
- In-Situ measurement
- OEG measurement
- REIG measurement
- coupler measurement
Why measure RECD?

RECD

(Real-Ear-to-Coupler Difference / Moodie, Seewald et. al. 1994)

RECD describes the difference of an acoustic response, measured in a 2cc-coupler and in an individual’s ear canal, using the same sound source, as a function of frequency in dB SPL

- The individual residual ear canal volume can be taken into account without the need of a complete In-Situ measurement for each fitting

- Calculated parameters can be stored

- Least possible strain for the patient
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RECD with Unity 2

UNITY™ 2
RECD with Unity 2

Start from NOAH module

Start from Unity environment
RECD with Unity 2

- Client list
- Connexx module
- Change ear sides
- Unaided measurement (Open ear gain)
- Insertion Gain
- Open Ear Spectrum
- RECD
- Probe tube calibration
- Session list
- Save fitting session
- Print fitting session
- SPL / Gain view
- Aided Measurement (InSitu and coupler)
- Input/Output diagram
- Sound Mapping
- Occluded measurement
- Occlusion effects
- End program
RECD with Unity 2

- RECD
- Probe tube calibration
- End program
RECD with Unity 2

Probe tube calibration
A **calibration** of the probe tube must be carried out prior to a real-ear measurement. It should be repeated every time the probe tube is replaced.
RECD with Unity 2
RECD with Unity 2
RECD with Unity 2

Unity 2 supports two different methods for obtaining RECD:

- With hearing instruments in free soundfield
- Through insert earphones
  
  (e.g. with EARtones ER3A / ER5A or using the Unity In-Situ – Headset)
RECD with Unity 2 – Freefield (with HI)

RECD measurement via Freefield (with HI):

1. In-Situ measurement
   - Gain measurement via HI at the eardrum

2. Coupler measurement
   - Gain measurement via HI in 2cc-coupler

⇒ Resulting difference = Real-Ear-to-coupler Difference (RECD)!
RECD with Unity 2 – Insert Earphones

RECD measurement via Insert Earphones

Options:

Insert Earphones for RECD →

Insitu headset

or Insert Earphones
  (EARtone ER3A / ER5A)

Unity → Settings
  → Devices → Settings
RECD with Unity 2 – Insert Earphones

Stage 1: Coupler Measurement

Stage 1: Coupler Measurement

Step 1: Attach Insert Earphone.

Step 2: If fitting a BTE instrument, attach the Insert Earphone directly to the HA2 Coupler. If fitting an ITE or ITC instrument attach the Insert Earphone to the Foam Tip or Earmold and then couple to the HA1 Coupler.

Step 3: Start the measurement by pressing 'OK'.

Important: Remember to have a calibrated insitu microphone connected!

Note: The recommended RECD Coupler Measurement Method when using the DSL[i/o] target formula is to attach the Insert Earphone directly to the HA2 coupler to make the measurement, regardless of the Hearing Instrument Type selected.
1a) Application of test signal to 2cc HdO - coupler (HA2)

via Insert Earphone

(EARtone ER3A/ER5A)
1a) Application of test signal to 2cc HdO - coupler (HA2) via Insert Earphone (EARtone ER3A/ER5A)
1b) Application of test signal to 2cc HdO - coupler (HA2)

via In-Situ headset (Unity)
1b) Application of test signal to 2cc HdO - coupler (HA2)

via **In-Situ headset**

(Unity)
2a) Determine the appropriate tube length for the probe microphone
2b) Attach an ear tip to the end of the handle. The handle contains both, the receiver tube and the probe tube.

The probe outlet of the handle tube should always be elongated with the short, 5mm tube to get the opening closer to the eardrum.
3a) Placement of probe tube in the ear canal

→ measuring sound pressure level directly at the eardrum
4a) Insertion of earmold

(+ connection of Insert Earphone)

→ Measurement setup more complex and time-consuming

BUT

→ Measured residual volume DOES consider the individual earmold
4b) Insertion of **Insitu-Headphone**

- Measurement faster, no separate In-Situ – tube necessary
- **BUT**
- measured residual volume does NOT consider the individual earmold
Stage 2: In-Situ measurement

5) Application of reference signal

6) Individual RECD measurement

Real Ear to Coupler Difference with Insertion Phones - Stage 2

Stage 2: Real Ear Measurement

Step 1: Insert probe tube into individual’s ear canal to the required insertion depth.

Step 2: If the Coupler Measurement was obtained using a HA2 Coupler connect the Foam Tip or earmold to the Insert Earphone and insert into the patient’s ear. If the coupler measurement was obtained using a HA1 Coupler insert the Foam Tip or Earmold into the patient’s ear.

Step 3: Start the measurement by pressing ‘OK’.

Important: Remember to have a calibrated insitu microphone connected!
Stage 2: In-Situ measurement

\[ \text{resulting curve} = \text{Real-ear-to-Coupler-Difference} = \text{RECD}! \]
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There are two ways to *insert* measured RECD values in ClinicalFit:

1. By clicking in the RECD grid once, a dialog comes up which enables the insertion of individual RECD for each frequency available by putting in numeric values.

2. By double clicking in the RECD grid to confirm the individual RECD for each frequency available. In this case, a tool tip gives additional information on which value (in dB) has been selected. Additionally, the inserted values are automatically displayed as numeric values in the dialog for manual insertion.
RECD with Unity 2 via Connexx ClinicalFit

Binaural Mode
You are in binaural Mode!
Please choose an ear side:

- Right
- Left

Measure RECD
RECD with Unity 2 via Connexx ClinicalFit

Parameters:

- HI Adaptive System: Initial / Off
- HI Microphone System: Directional / Omnidirectional
- LO Max (Maximum Level Output, default: 105 dB SPL)
- Test Signal (default: White Noise)
- LI (Level Input, default: 65 dB)

Response Curve display list (show / print / delete)

Tube Calibration

Start/Stop
RECD with Unity 2 via Connexx ClinicalFit: 
Probe Tube Calibration

Siemens Unity2 Probe - [Right Hearing Instrument]

Adaptive System
- Initial
- Off

Microphone System
- Directional
- Omnidirectional

Response Curve
- 65dB RECD

LO Max
- Test Signal: White Noise
- Measurement: RECD
- 105dB

Tube Calibration

Calibration Wizard

This application is used to calibrate the different components of your Unity System.

The calibration is done step by step in different wizards. First, you should select the calibration you like to do now. Press OK to start with the calibration procedure you selected.

What do you like to do?
- Unity SD 100 Audiometer Soundfield Calibration
- Unity Probe Calibrator
- Unity Testbox Coupler and Microphone Calibration
- Unity Testbox Telecoil Calibration

Start

Close
A **calibration** of the probe tube must be carried out prior to a real-ear measurement.

It should be repeated every time the probe tube is replaced.
RECD with Unity 2 via Connexx ClinicalFit – Freefield (with Hi)
RECD measurement via Freefield (with HI):

1. In-Situ measurement
   - Gain measurement via HI at the eardrum

2. Coupler measurement
   - Gain measurement via HI in 2cc-coupler

→ Resulting difference = Real-Ear-to-coupler Difference (RECD)!
RECD with Unity 2 via Connexx ClinicalFit – Insert Earphones

Siemens Unity2 Probe - [Rechtes Hörsystem]

Adaptives System
- Ursprünglich
- Aus
- Direktional
- Omnidirektional

Frequenzkurven
- 75dB RECD

LA Max
- Prüfsignal
- Weißes Rauschen
- 75dB

LE
- 105dB

Messkurve
- RECD

RECD: Which transducer is applied for the measurement?

- Freefield
- Insert Earphone

Ok
Cancel
RECD with Unity 2 via Connexx ClinicalFit – Insert Earphones

RECD measurement via Insert Earphones

Options:

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Insitu Headphone

or Insert Earphone
(EARtone ER3A / ER5A)

Unity → Settings → Devices → Settings
Stage 1: Coupler Measurement

- **Step 1:** Attach Insert Earphone.
- **Step 2:** If fitting a BTE instrument, attach the Insert Earphone directly to the HA2 Coupler. If fitting an ITE or ITC instrument, attach the Insert Earphone to the Foam Tip or Earmold and then couple to the HA1 Coupler.
- **Step 3:** Start the measurement by pressing 'OK'.

Important: Remember to have a calibrated in situ microphone connected!

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via Insert Earphone

(EARtone ER3A/ER5A)
1a) Application of test signal to 2cc HdO - coupler (HA2)

via Insert Earphone (EARtone ER3A/ER5A)
1b) Application of test signal to 2cc HdO - coupler (HA2)

via In-Situ Insert Earphone (Unity)
1b) Application of test signal to 2cc HdO - coupler (HA2)

via In-Situ Insert Earphone (Unity)
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3a) Placement of probe tube in the ear canal

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4a) Insertion of **earmold**

(+ connection of Insert Earphone)

→ Measurement setup more complex and time-consuming

**BUT**

→ Measured residual volume **DOES** consider the individual earmold
4b) Insertion of Insitu-Headphone

- Measurement faster, no separate In-Situ – tube necessary
- BUT
- measured residual volume does NOT consider the individual earmold
Stage 2: In-Situ – Measurement

5) Application of reference signal

6) Individual RECD measurement
Stage 2: In-Situ – Measurement

**red** curve: measured RECD

**blue** curve: statistical RECD
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RECD in Unity: Extended Options

Manual access to DSL v5 dialog
DSL v5 Configuration:

- (developmental) Age
- Transducer used for Assessment
- RECD type
- Number of HI Channels
RECD in Unity: Extended Options

→ DSL v5 Configuration

→ Advanced Settings
Verification in Unity:
Insert measured RECD in Unity

- DSL v5 Configuration
- Advanced Settings
- RECD options:
  Predicted / Measured / Manual
- RECD “Manual”:
  Insert values for Left / Right ear
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Insecure Measurements / Possible Pitfalls:

1. Capping at 2 - 3 kHz

2. Negative values at lower frequencies (-1 to -9 dB)

3. Negative values at lower frequencies (-10 to -15 dB)

4. Positive values at low and medium frequencies

RECD: Possible Pitfalls

1. Insertion of Probe Tube not deep enough

2. Acoustical leak / venting

3. Grommets or perforation

4. Eardrum problems / effusion
Summary

RECD with Unity 2 and Connexx 6.3 ClinicalFit:

- Use of individually measured or statistical (age-related) RECD
- Optimal support especially for pediatric fittings
- Perfect amendment through verification options via Unity
- Safe and effective fitting!