

AppNote

The REDD is defined as the difference, in dB as a function of frequency, between the SPL measured at the eardrum and the audiometer dial setting that produced it. It is specific to the client, headphone and audiometer used to generate it.

The REDD can be used to accurately predict the ear canal SPL for threshold and uncomfortable loudness level (UCL) when headphones have been used for audiometry.

NOTE: The real-ear-to-coupler difference (RECD) is used to obtain real-ear SPL estimates when insert earphones are used for audiometry [See Cole & Sinclair (1998) or AppNote 99-07 for details].

Direct measurement of real-ear SPL threshold values can be difficult because of noise floor limitations associated with probe microphone measurement equipment.

The REDD measurement can be performed at the time of the hearing assessment. The values can be printed and re-entered when the client is seen on subsequent visits. The Audioscan NOAH module can be used to facilitate this process.

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Performing Real-Ear-to-Dial Difference (REDD) Measurements Using the Audioscan® RM500

with software version 2.6 or higher¹

Because hearing instruments ultimately deliver sound to the eardrum, accurate threshold and uncomfortable loudness level (UCL) data in terms of eardrum sound pressure level (SPL) are essential for successful hearing instrument fitting.

The traditional dB HL audiogram has limitations when used for defining hearing levels for the purpose of choosing an appropriate hearing instrument (Hawkins, Cooper, & Thompson, 1990). This is because audiometers are calibrated in dB HL referenced to normal average adult hearing threshold. The greater the individual's ear acoustics deviate from those of the average adult, the greater the inaccuracy in precisely defining the client's thresholds and UCLs in dB SPL at the eardrum.

To improve the accuracy of assessment data collected using headphones (and the resulting amplification targets), the Speechmap/DSL fitting system provides a method for quickly measuring the individual's unique HL to SPL transform values: the REDD. This measurement enables precise definition of the individual's auditory area for the purposes of selecting and fitting amplification.

Results of a recent study investigating the Speechmap/DSL REDD measurement procedure showed good agreement between predicted and measured real-ear SPL values (Scollie, Seewald, Cornelisse & Jenstad, 1998).

ACCESSING THE REDD MEASUREMENT PROCEDURE

To measure the REDD on the Audioscan RM500 real-ear system:

1. Calibrate both the hearing aid test (HAT) box and real-ear measurement (REM) sections of the RM500 (see RM500 User's Guide for details).
2. Ensure the RM500 is in REM mode. (If necessary, to select REM mode, press any key in the REM area of the keyboard.)
3. Press the <ADVANCED FEATURES> key.
4. Highlight TESTS and SPEECHMAP/DSL. Press <CONTINUE>.
5. Press the <AGRAM> key to display the ASSESSMENT DATA ENTRY POSTER.
6. Using the cursor arrows on the keyboard, scroll through the window at each item to select specific client information (AGE, TRANSDUCER, UCL, RECD and REDD). Set TRANSDUCER to HEADPHONES. Set REDD to MEASURE. Press <CONTINUE>.
7. Enter the client's audiometric information by following the onscreen instructions. Press <CONTINUE>.
8. The RM500 will automatically advance to the REDD measurement procedure. Onscreen instructions are provided to facilitate the measurement.

The Speechmap/DSL fitting system converts the entered threshold and UCL data from dB HL to dB SPL at the eardrum (SPL_{TM}) as a function of frequency via the following formula:

$$SPL_{TM} = dB HL + REDD$$

Complete details of how the REDD measurement is used in the Audioscan RM500 Speechmap/DSL fitting system are provided in Cole & Sinclair (1998)

At each frequency, the RM500 measures the SPL at the individual's eardrum, calculates the REDD ($SPL_{TM} - 70$) and plots it on the screen.

The measured REDD values, as a function of frequency, should generally be greater than 0 dB. A negative REDD value might indicate an inadequate seal of the headphone over the ear, blocked probe tube, or improper probe tube placement.

References:

Cole WA, Sinclair ST (1998). The Audioscan RM500 Speechmap/DSL Fitting System. *Trends in Amplification*, 3(4):125-139.

Hawkins DB, Cooper WA, Thompson DJ (1990). Comparison among SPLs in real ears, 2cm³ and 6cm³ couplers. *Journal of the American Academy of Audiology*, 1:154-161.

Scollie, SD, Seewald RC, Cornelisse LE, Jenstad LM (1998). Validity and repeatability of level-independent HL to SPL transforms. *Ear and Hearing* 19:407-413.

MEASURING THE REDD

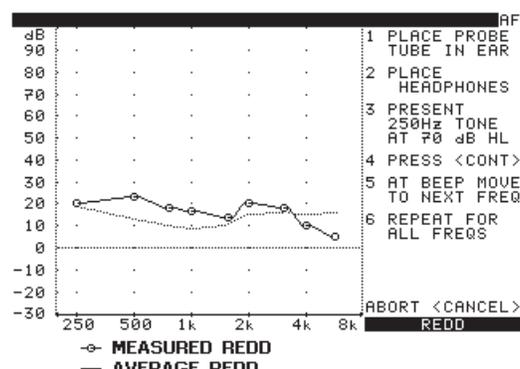
1. Plug the probe module into the microphone jack inside the hearing aid test (HAT) box.
2. Prepare the client for real-ear measurements. Ensure the probe tube is within 5 mm of the eardrum (see RM500 User's Guide for details).
3. Place the same headphones used during the audiometric assessment over the client's ears, being careful not to move the inserted probe tube.
4. Set the audiometer dial frequency to 250 Hz and present a 70 dB HL continuous tone from the audiometer.
5. Press <CONTINUE> to start the measurement procedure. The RM500 will prompt onscreen "Waiting for 250 Hz." When the RM500 has obtained a REDD measure, an audible 'Beep' will be heard, indicating that you should advance the audiometer frequency setting.
6. Set the audiometer to 500 Hz and again present a 70 dB HL continuous tone until the RM500 prompts you to advance to the next frequency. Repeat the process until a REDD measure has been obtained for all octave and interoctave audiometric test frequencies. The total measurement time required is approximately 10 seconds.



Note: If a tone is not presented at an interoctave frequency within 5 seconds of the last REDD measure, the RM500 will automatically advance to the next frequency.

REDD MEASUREMENT SCREEN

Individual REDD values will be plotted onscreen at each frequency during the REDD procedure. Once the process is complete, these points will be connected to reveal the measured REDD curve. The average adult REDD is also displayed for comparison purposes. If the measured REDD curve is below 0, check that the headphones are correctly covering the individual's ear. If the measured REDD is below 0 in the 4 – 6 kHz region, check for proper placement of the probe tube (i.e., within 5 mm of eardrum) and blockage of the probe tube.



THE UNAIDED SPLOGRAM SCREEN

Following completion of the REDD measurement procedure, the RM500 automatically proceeds to the Speechmap/DSL unaided SPLogram screen. The dB SPL threshold and UCL values displayed are calculated using the individual's measured REDD data. The measured REDD values can now be obtained in numerical form at the top of the SPLogram printout by pressing <PRINT SCREEN>. If desired, these REDD values can be re-entered into the RM500 at a later date by scrolling to ENTER in the REDD window of the ASSESSMENT DATA ENTRY POSTER.