Speech Audiometry An overview

Pure tone audiometry provides only partial information about a patient's ability to hear and, most importantly, to understand speech — the most relevant auditory signal in daily life. To evaluate how well a patient perceives spoken language, speech audiometry is performed.

In speech audiometry, the patient is presented with a series of standardized speech stimuli — typically single syllables, words, or phrases — designed to assess specific aspects of auditory performance.

Selection of input

The speech material can be presented directly by the operator speaking into a microphone (connected to the MIC or TALK OVER input on the rear panel, depending on the setup), or delivered from an external audio source connected to the dedicated input of the audiometer (EXT1 and EXT2).

In the case of Inventis stand-alone audiometers, speech material can also be stored in internal flash memory (INT1 and INT2). For Inventis PC-based systems, speech material indexed and saved on the computer can be released via USB1 or USB2 inputs.

Adjustment of input gain

Before starting a speech audiometry test, the gain level of the selected input must be adjusted. This ensures that the recorded speech material (or the operator's voice in case of live speech) is reproduced at the correct volume.

- For **recorded speech material**, the gain is correct if, when playing the calibration tone supplied with the material, the loudness measured on the VU-meters of both channels reaches 0 dB, i.e., the point where the meter changes from green to red.
- For **live speech tests**, the gain is correct if the mean value shown on the channel 1 VU-meter is 0 dB while speaking the test words at the normal distance from the microphone.

On Inventis audiometers, if the level is incorrect, pressing the GAIN button allows adjustment using the two knobs on the front panel. The gain setting for each input is stored by the instrument and is automatically recalled even after the device is switched off and restarted.

Selection of output

The speech signal can be presented to the patient through headphones (AC), loudspeakers (FF), or the bone vibrator (BC). For headphones and loudspeakers, the operator can select the presentation side: right, left, or bilateral.

Inventis audiometers allow the clinician to enable the free-field equivalent filter for headphone output. This filter, defined by international standards, ensures that speech audiometry results obtained via headphones are as close as possible to those obtained under free-field conditions.

### MASKING AND COMPETING SIGNAL

As in pure tone audiometry, masking can also be applied in speech audiometry to prevent measurement errors caused by cross-hearing. The recommended masking signal in this case is speech noise (SN), which concentrates its energy within the frequency band of the human voice. Most audiometers also provide white noise (WN) as an alternative masking option.

Beyond masking, speech audiometry can also be performed with the addition of a competing signal to better simulate real-life listening conditions, such as environments with background noise. This competing sound can be delivered either to the test ear or to the contralateral ear, and may consist of speech noise, white noise, or even a dedicated competing track embedded in the speech material itself (recorded on the opposite channel to the test word lists).

ARTICULATION FUNCTION, SPEECH RECOGNITION AND SPEECH DETECTION THRESHOLDS

The articulation function (also known as the performance–intensity function) describes how a patient's speech recognition ability varies with the level of speech intensity. It is essentially a curve that plots the average percentage of correctly recognized speech items (words, syllables, or phrases) against their presentation level.

The graph below illustrates two articulation functions: one for lists of spondaic words (solid line) and one for lists of monosyllabic, phonetically balanced words (dotted line).
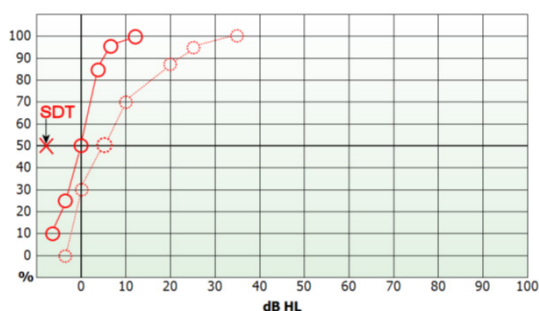
The intensity level at which 50% of spondaic words are repeated correctly is called the Speech Recognition Threshold (SRT). For adults with normal hearing, the average SRT is around 20 dB SPL, which EN 60645-2 defines as equivalent to 0 dB HL. In speech audiometry, conversion from dB SPL to dB HL is obtained simply by subtracting 20 dB.

In subjects with normal hearing, the articulation function shows a steep slope: nearly 100% correct responses are typically reached at 27.5 dB SPL (7.5 dB HL).

Also shown in the graph is the Speech Detection Threshold (SDT) — the level at which the patient detects the presence of speech (without necessarily recognizing it) 50% of the time. For normal-hearing individuals, the SDT is about 13 dB SPL (−7 dB HL).

SPEECH AUDIOMETRY INTERFACE

To perform a speech audiometry test, the dedicated interface (or "window") is typically accessed from the main menu of the audiometer. The interface generally displays the articulation curves for the right and left ear. As with pure tone audiometry, results may be shown on separate graphs or combined into a single view, depending on operator preference.

For example, in Inventis audiometers, the operator can toggle between the two display modes by pressing the Display button at the bottom of the screen.
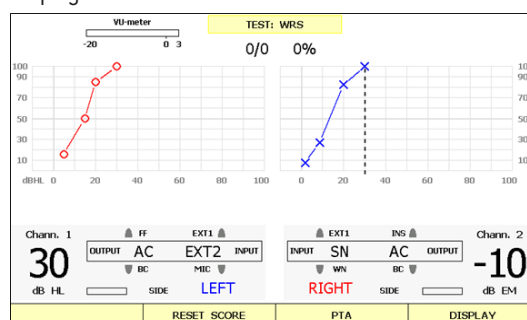
Key information displayed

Most audiometers group essential test information in a structured way on screen, typically including:
- Intensity level
- Channel status (active/inactive)
- Input signal (e.g., microphone, recorded material, or external source)

- Transducer used (headphones, free field loudspeakers, or bone vibrator)
- Stimulation side (right, left, or both)

At the top of the interface, additional data is often shown, such as:
- Correct and incorrect responses
- Percentage of correct responses (depending on the scoring method set in the instrument)
- VU-meters for one or both channels
- The selected test type (e.g., WRS, SRT, MCL, UCL)

In Inventis systems equipped with internal flash memory, further details may be displayed, such as:
- The currently selected speech material
- The list number
- The last word presented (if the material is indexed)
- The status of the playback (play, pause, stop)

<u>Input and responses</u>
Live speech audiometry can be performed with a talkover microphone or, where supported, a desktop microphone. In the case of Inventis devices, the operator can select the preferred option in the settings menu. The desktop microphone should be positioned no more than 15 cm from the mouth to reduce background noise.

Patient responses are recorded using buttons or keys typically labeled Correct and Incorrect. Depending on the instrument settings, the scoring method may vary. For example, in Inventis audiometers, two scoring modes are available:
- **Mode 1**: both Correct and Incorrect answers are actively logged, with a reset option to clear counters.
- **Mode 2**: only correct responses are logged; pressing Incorrect serves only to rectify an error.

<u>Special options</u>
Some systems also allow the Word Recognition Score (WRS) to be calculated as a single point instead of a full curve. In Inventis audiometers, when this "WRS single point" mode is active and the output is air conduction or free field, the same input can be used on both channels, enabling the operator to deliver the same material to right and left ears simultaneously but at different intensity levels.

In addition to WRS, audiometers may provide direct measurement of single thresholds such as Speech Recognition Threshold (SRT), Most Comfortable Level (MCL), and Uncomfortable Level (UCL), selectable from the interface.

BIBLIOGRAPHY

1. Penrod J.P., Speech Threshold and Word Recognition / Discrimination Testing, Handbook of Clinical Audiology, 147-164, Katz J. Editor, Williams & Wilkins (1994).
2. EN ISO 8253-3 standard, "Audiometric test methods. Speech audiometry".

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