Supra-threshold tests
An overview

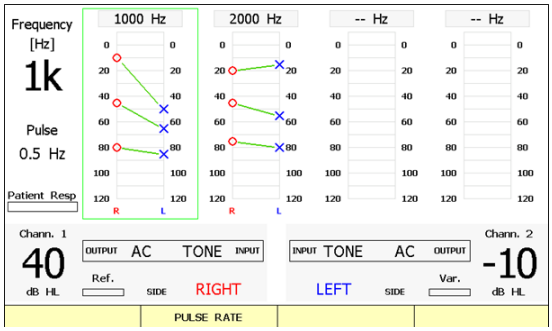
PRODUCT INSIGHTS

While pure-tone and speech audiometry provide valuable information about conductive, sensorineural, or mixed hearing loss, supra-threshold tests allow the clinician to investigate hearing damage in greater detail. In particular, these tests help differentiate between cochlear and retrocochlear disorders.

ABLB (FOWLER)

The Alternate Binaural Loudness Balance (ABLB) test is designed to determine the presence of recruitment. It is typically applied in cases of unilateral hearing loss or when there is an asymmetry of 25–60 dB between the air-conduction thresholds of the two ears at a given frequency.

The test consists of presenting a tone alternately to the better ear (reference ear) and the poorer ear, always at the same frequency but at different intensity levels. The clinician increases the intensity in the good ear step by step and finds the matching level in the impaired ear that is perceived as equally loud by the patient. The resulting pairs of values are then plotted to create a loudness balance graph.



ABLB Test Window (Inventis instruments)

On Inventis audiometers, the ABLB test window is structured as follows:

- The channel linked to the better ear is labeled **Ref**, while the channel for the poorer ear is labeled **Var**.
- Four graphs are displayed side by side, each corresponding to a test under different conditions (stimulus frequency or ear side). The active graph is highlighted by a green rectangle.
- The **Pulse Rate** button sets the alternation speed of the stimulus between ears, with selectable values of 0.5 Hz, 1 Hz, or 2 Hz.
- Once four tests have been stored, the clinician can navigate between them using the **Frequency** buttons, provided the selected Ref channel matches the side

of the good ear.

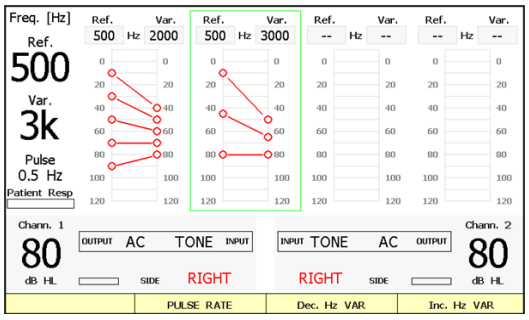
The procedure generally begins by presenting tones at each ear's hearing threshold for the test frequency. The intensity in the good ear is then increased by 10–30 dB steps. For each increase, the intensity in the poorer ear is adjusted until the patient perceives equal loudness in both ears. At that point, pressing the **Store** button records the pair of values on the loudness balance graph.

MLB (MONAURAL LOUDNESS BALANCE, REGER)

The Monaural Loudness Balance (MLB) test is recommended for patients with bilateral hearing loss. It consists of presenting two alternating tones to the same ear, at different frequencies and intensities.

The purpose of the MLB test is to determine whether the difference in hearing sensitivity between two frequencies remains constant at supra-threshold intensities, or whether it decreases due to the presence of recruitment.

As with the ABLB exam, the goal is to find, for different intensities of the reference frequency (the better-hearing frequency), the corresponding intensity values of the variable frequency (the poorer frequency) that the patient perceives as equally loud. The resulting pairs of values are plotted on an intensity balance graph.



MLB Test Window (Inventis instruments)

In the test interface, the channel associated with the reference frequency is labeled **Ref**, while the one associated with the variable frequency is labeled **Var**.

- Four graphs are displayed side by side, representing results under different combinations of frequencies and test sides.
- The active graph (corresponding to the frequency and side currently selected) is highlighted with a green rectangle.
- The **PULSE RATE** control allows the operator to set how quickly the tone alternates between the two frequencies, with selectable values of 0.5 Hz, 1 Hz, and 2 Hz.

Once up to four different tests have been saved, the operator can switch between them using the **Frequency** buttons.

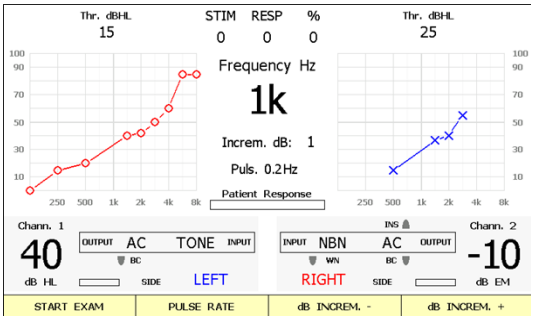
The test typically begins with both tones set at the patient's hearing threshold for the two selected frequencies.

1. The intensity of the reference frequency is gradually increased.
2. After each increment, the intensity of the variable frequency is also raised until the patient perceives the two tones as equally loud.
3. Each pair of matched values can then be saved to the **intensity balance graph** by pressing the **STORE** command.

SISI (JERGER)

The Short Increment Sensitivity Index (SISI) test assesses the ability of the ear to identify brief variations of intensity in a continuous pure tone.

As a rule, the test is conducted by presenting a continuous pure tone at different frequencies, selecting an intensity 20 dB above the hearing threshold identified previously for the ear and at the test frequency, introducing small increments in intensity of short duration and asking the patient to press the button each time an increment is perceived.



SISI Test Window (Inventis instruments)

- The lower part of the window shows the same items of information relating to channels 1 and 2 as in pure tone audiometry.

- The middle section displays the frequency of the tone and the rate at which increments are presented. This value can be adjusted (e.g. 0.2 Hz, 0.5 Hz or random, with the interval changing at each increment).
- The upper section shows the progress of the test: number of increments presented (STIM), number of responses made by the patient (RESP), percentage of correct responses (%), and the PTA threshold of the selected output.
- The central part of the display shows the SISI graphs for right and left ears, indicating the percentage of increments detected at each frequency.

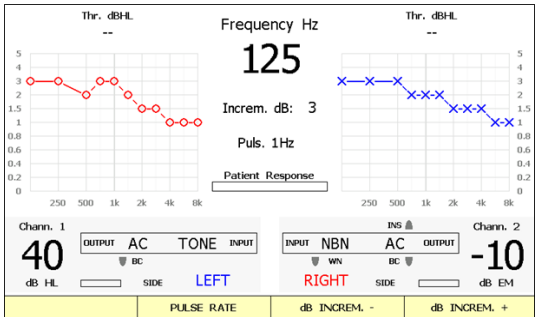
The amplitude of the increments can be set to 0.4, 0.6, 0.8, 1, 1.5, 2, 3, 4 or 5 dB. Increments of 5 dB should be used only for the initial familiarization stage of the test, during which responses are not counted.

The SISI test is automatic. Once the frequency and intensity of the tone have been set, pressing the **START EXAM** button initiates a sequence of 20 increments. A response is counted only if the patient presses the button within one second of the increment. The test ends automatically once all 20 increments have been presented, though it can be stopped manually with the **END EXAM** button.

Increments of 1 dB are normally imperceptible or barely perceptible for individuals with normal hearing, conductive loss or retrocochlear pathology. If the patient detects more than 30% of the increments, this may be indicative of a cochlear disorder.

DLI (LŰSCHER)

The Difference Limen for Intensity (DLI) test is very similar to the SISI test. Its purpose is to evaluate the amplitude of the smallest variation in intensity of a pure tone that can be perceived by a patient. There appears to be a connection between recruitment and the ability to distinguish increments smaller than 1.5 dB HL.



DLI Test Window (Inventis instruments)

The DLI test window presents information similar to that of the SISI test.

- The lower part of the display shows the same channel status details.
- The central area displays the current frequency, the amplitude of the selected increments, and their repetition rate.
- Above the graphs, the PTA thresholds measured previously at the current frequency for the selected transducer are shown.

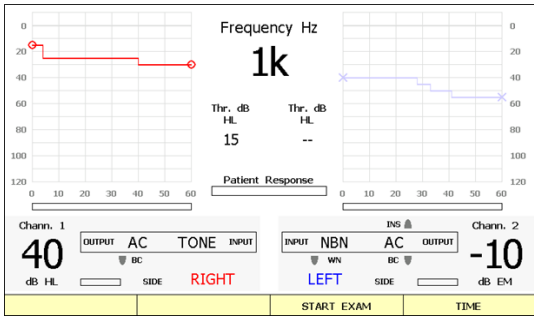
The two graphs represent the minimum amplitude of increments perceived by the patient at the test frequency, separately for the right and left ear.

The procedure involves presenting a pure tone at an intensity approximately 40 dB above the audiometric threshold, introducing increments at regular intervals of 0.5 Hz, 1 Hz, or 2 Hz (selected via the **PULSE RATE** control). Initially, the increment value is set to 0 dB and then gradually increased using the **dB Increment +** control, until the patient reports that the continuous tone is perceived as a pulsed tone. Once this level is identified, it is saved on the graph with the **Store** function.

Possible increment values include: 0, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.5, 2, 3, and 5 dB.

TONE DECAY

The Tone Decay test is a monaural procedure used to reveal cases of pathological adaptation and fatigue, that is, loss of hearing sensitivity associated with continuous acoustic stimulation.



The Tone Decay Test Window (Inventis instruments)

As in the previously described tests, the lower part of the window displays the status of channels 1 and 2. Shown in the center, between the graphs, are the current frequency and the tone thresholds (for right and left ear) identified previously for the selected frequency. This information is useful in determining the starting intensity for the test.

The central part of the screen is occupied by the tone decay graphs for the right and left ear:

- the x-axis indicates time (in seconds),
- the y-axis indicates the intensity level of the tone presented to the patient.

Up to four traces can be displayed for the selected stimulation side, each corresponding to a specific frequency. The trace for the current frequency is highlighted in a stronger color. Below each graph, a progress bar indicates the total duration and the time elapsed since the start of the test.

A continuous tone is presented to the patient, usually by air conduction, at the selected frequency and at an intensity equal to the threshold previously measured for that frequency. The patient is instructed to press and hold the response button as long as the tone is audible, and to release it once the tone can no longer be heard. At this point, the operator increases the stimulus intensity by 5 dB and the test continues.

The duration of the test can be set to 60 or 120 seconds, using the DURATION button. The procedure is started with **START EXAM** and can be interrupted at any time with the **END EXAM** button (which replaces START once the test is in progress).

As mentioned above, the graph can contain up to four traces. Once four frequencies have been tested, the START function is disabled unless one of the existing traces is deleted using the ERASE DATA button.

The difference between the initial stimulus intensity and the final intensity reached at the end of the test reflects the degree of adaptation. Adaptation values of 5–10 dB for a 60-second test are considered physiological.

TEN TEST

The TEN (Threshold Equalizing Noise) test is a clinical procedure designed to assist in the detection of **dead regions in the cochlea**. It was developed and validated by Dr. Brian C. J. Moore at the University of Cambridge, with the goal of providing an easy and reliable tool for everyday clinical use.

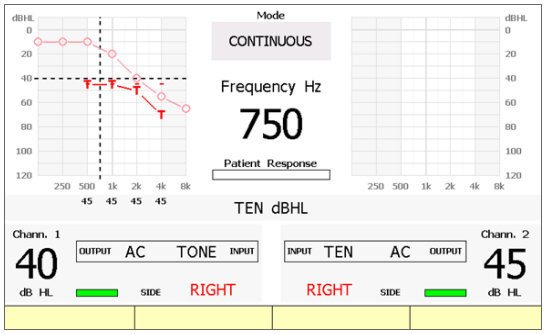
The test consists in measuring the threshold for detecting a pure tone when it is presented against a specific type of background noise called **threshold-equalizing noise (TEN)**.

Before running the TEN test, the patient's pure-tone thresholds between 500 and 4000 Hz must be assessed. Once the audiogram is obtained, the TEN test can be accessed from the main menu of the audiometer, where the test window is displayed on the background of the audiogram graph.

During the test, TEN noise is added to each pure-tone stimulus with a level set at least 10 dB above the audiometric threshold for the same frequency. Both tone and noise are presented to the same ear. If the masked threshold is at least 10 dB higher than both the original pure-tone threshold and the TEN noise level, the presence of a dead region at that frequency is assumed.

The TEN test screen allows the operator to select the stimulated ear and adjust the respective intensity levels of both tone and noise. As in pure-tone audiometry, it is possible to present pulsed stimuli and use functions such as tracking or lock.

Stored masked thresholds are shown directly on the audiogram, marked with the symbol "T", along with the corresponding masking level.



The Ten Test Window (Inventis instruments)

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