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MANUAL FOR THE GROEN-ΔT-METER.

Try the instrument first on yourself: tap gently with a light pencil (or simular device) on the rubber tube, without touching the brass enclosure. Keep the instrument loosely in your left hand by the grip. Develop a light toucher. You will notice that the pulse intensity is remarkably high. Even severely deaf people can be examined: one has to tap then somewhat stronger. But: begin always with a slight tap; increase if necessary.

1) Put the ear muffs over the ears of the testee. Look out for leaks; the muffs should fit perfectly. Tap the tube on a spot located e.g. 10 cm. away from the centre (marked 0). Normally. the testee will locate the sound in the ear nearest to the place you tapped. Repeat the procedure but now on the other side only 5 cm. away from the centre. If the testee locates the sound correctly, go on tapping alternately, gradually approaching zero until no lateralization to the correct side is made anymore; usually a midline interpretation results.

2) The normal margin of error of the unobservant listener is about 1.5 cm around the centre. This means that the difference in distance between the ears for the travelling waves is 2 x 1.5 = 3 cm. This amounts roughly to 90 microseconds, each centimeter needing 30 μs (more exact 28.5 μs).
The trained listener will distinguish priority even at 0.5 cm, which stands for a timedifference between the ears of 30 μs (2 x 0.5 = 1 cm).

3) The ability for lateralisation, i.e. time-differencediscrimination (Δt-ability), depends on the following.
a. The age of the testee. Very young children and old people need 3 cm (2 x 3→180 μs). Between 6 and 50 years 1 cm (2 x 1→ 60 μs) may be sufficient to cause a lateralization; observant listeners need only 0.5 cm (2 x 0.5 →30 μs) See above.

b. Type of hearing impairment. Unilateral or bilateral conductive loss does not disturb Δt-ability, be it that the centre-localization is shifted away from tube centre towards the poorer ear. In middle ear processes the margin of error is normal (0.5 - 1.5 cm around the subjective centre). Purely cochlear lesions (degenerations of Organ of Corti, noise trauma) do not disturb Δt-ability. Again: subjective centre may be displaced on the tube towards poorer ear, without affecting margin of error.

Any disturbance in neural conductive properties in 1st or 2nd neuron, be it ever so slight, will reduce Δt-ability; a margin of error exceeding 3 cm (2 x 3 → 180 μs) is already pathological. These larger values (> 3 cm) are found in presbyakusis and pathological nerve conditions. Acoustic neurinoma, pontine tumour (or similar severe neural disturbance lead to <u>complete inability</u> for time-difference-discrimination.

4) It is of importance to stress, that the ability for intensity-difference-discrimination may be normal even in cases of acoustic neurinoma and other nerve affecting processes. Directional hearing for continuous high tones (> 800 Hz) is mainly based on the discrimination between the slightly different sound intensities at the entrances of the two ears. Hence the ability for directional hearing in the higher frequency range is in itself no indication that retrocochlear neural conditions should be normal. Only by using pure time-differences is it possible to demonstrate an impairment of neural signal transportation. It is the conduction velocity along the nerve which is first affected by a space-occupying process. As the ability for time-difference-discrimination depends primarily on neural signalconduction, the tube-Δt-test is an extremely usefull tool for the diagnosis of disturbances in 1st and/or 2nd neuron.

The tube only introduces time-differences and no appreciable intensity-differences. Even at the extreme spot, 15 cm away from the centre, the intensity-difference between the ears does not exceed 1 dB.

5) For experimental purposes a tuning fork may be applied with its stem on the tube; a bone conduction receiver also may serve. The position of the vibrator on the tube determines the phase difference between the ears, depending further on the frequency of the vibrator. Especially the lower frequencies (< 800 Hz) are of interest. Do not move the vibrating instrument ever so slightly over the tube, because it will start sound pulses which will give rise to orientating clues.

6) Directions for wearing and adjusting.
It is essential for reliability of Δt-data that the ear muffs be properly adjusted before wearing.
1. The head frame can be easily adjusted for correct fit without removing from wearer's head. Note that the metal crown strap is slotted. Simply by raising the spring clip away from the band and sliding up or down, repositioning is effected. This can be done on each side to conform to the wearer's comfort. The nylon frame cover is removable for washing.
2. The fluid-filled cushions are shaped and identified as front and back. The cushion is lettered on the underneath side. The letter "C" in the word "back" as printed on the ear cup should be lined up with the raised receptacle for the head frame. Stretch the cushion over the protruding edge of the plastic ear cup. Cushions are interchangeable right and left. In replacing a cushion, it is important that it be adjusted to the cup. This is done by placing a finger under the cushion, between the cushion and the base plate.

Adjustment in this manner assures proper fit of the rubber retaining ring against the cup edge and smooths the under surface of the fluid-filled cushion.

4. The ear muffs can be easily disassembled without tools, for cleaning and sterilizing. Use warm soapy water. Do not use alcohol or organic solvents for cleaning. These solutions affect the plasticiser in the ear cushions.