NHSP recommended stimulus reference levels for ABR systems

NHSP ABR Reference Levels for Stimulus Calibration										
AC RETSPL dBppeSPL for supra-aural earphones	**Clicks**	**2:1:2 cycle tone pips**				**Chirp**	**Narrow Band Chirps~**			
		500	***1000***	***2000***	***4000***		***500***	***1000***	***2000***	***4000***
TDH39 / IEC 60318-1 wideband artificial ear	**31.0**	**23.0**	**18.5**	**25.0**	**27.5**	27.5	26.0	21.5	27.0	30.0
TDH39 / IEC 60318-3 (6cc, NBS-9A) coupler (note 2)	31.0	23.0	18.5	25.0	27.5	27.5	26.0	21.5	27.0	30.0
AC RETSPL dBppeSPL for insert earphones (note 3)	**Clicks**	**2:1:2 cycle tone pips**				**Chirp**	**Narrow Band Chirps~**			
		500	***1000***	***2000***	***4000***		***500***	***1000***	***2000***	***4000***
ER-3A / IEC 60318-4 (IEC 60711) occluded ear simulator	**35.5**	**23.5**	**21.5**	**28.5**	**32.5**	32.0	26.5	24.5	30.5	35.0
ER-3A / IEC 60318-5 (2cc coupler, HA-2) (note 4)	26.5	19.5	16.0	20.0	23.0	22.0	22.5	18.5	22.0	25.0
BC RETVFL dBppeVFL (re 1uN) for bone vibrators	**Clicks**	**2:1:2 cycle tone pips** (note 6)				**Chirp**	**Narrow Band Chirps~**			
		500	***1000***	***2000***	***4000***		***500***	***1000***	***2000***	***4000***
B71/B70 **& IEC 60373 (will become IEC 60318-6)** (note 5)	**51.5**	69.5	58.5	47.5	53.0	51.5	75.0	61.5	50.0	55.5

Notes

1. Reference levels in the table **in bold** are from ISO 389-6 (2007). Figures not in bold are where no values are available from ISO 389-6(2007) and are those recommended by NHSP. Stimulus rate: 20/s. Adult listeners.
2. If the calibration is made using the same reference values with a 6cc coupler (IEC 606318-3) instead of an artificial ear, click and tone pip stimuli intensities are likely to be slightly greater at a given indicated hearing level. The differences are thought to be less than 2 dB. The 6cc coupler is therefore an acceptable alternative to the artificial ear, but if it is used the calibration would not comply with IEC 389-6.
3. **Warning**: when using inserts, the sound pressure level in a neonate's ear canal is likely to be 10-20 dB greater than it would be in an adult's ear. This is an effect of canal volume and can mean that the stimulus rises to unsafe levels which can cause cochlear damage. Advice on this and related advice on headphones is covered under maximum stimulus levels in the current NHSP document "Guidelines for the early audiological assessment and management of babies referred from the newborn hearing screening programme".
4. A 2cc coupler (IEC 606318-5) is an acceptable alternative to an occluded ear simulator although its use does not comply with ISO 389-6. Reference values for the coupler can be derived from those for the ear simulator as follows:
   clicks subtract 9.0 dB (Haughton, P. 2006. Int J Audiol 45: 60-65);
   tone pips subtract 4.0, 5.5, 8.5 and 9.5 dB at 0.5, 1, 2 & 4 kHz respectively (differences in the RETSPLs for continuous tones). The tabulated values for clicks and tone pips have been derived in this way or by direct measurement data where this was available.
5. Reference values are for the B71 vibrator. The curved stylus of the B70 does not comply with IEC standards, which specify a plane contact face. Measurements suggest that calibration errors associated with the use of a non-standard (B70) vibrator will be less than 3dB. However, the B71 model is preferred and some calibration laboratories will refuse to calibrate B70 transducers.
6. BC tone pip data have been derived by adding differences between the reference levels for tone pips and continuous tones (AC) to the ISO reference force levels (BC) for continuous tones. (Fedtke & Richter, 2005 and ISO 389-3). Interim values only.
7. The values for chirps and narrow band chirps were derived for ER3A inserts by PTB, Physikalisch-Technische Bundesanstalt. (Fedtke & Hensel, 2008). Test Report (2008-07-22), Audiometric headphone, ER-3A, MAICO Diagnostic GmbH. Transfer data were applied to derive equivalent values for other transducer/coupler combinations.
8. The reference levels tabulated above are appropriate when using the peak-peak equivalent measurement method specified in IEC 60645-3 (2007). Equipment should be calibrated at a level that is comfortably above that of the background noise but low enough to avoid the risk of distortion. Recommended levels are 70-80 dBHL (AC) and 30-40 dBHL (BC).
9. "Clicks" and "tone pips / bursts" are the reference stimuli defined in IEC 60645-3 (2007).
10. These reference levels supersede previously recommended levels.
11. It is all too easy to introduce calibration errors by failing to correctly account for microphone and artificial mastoid sensitivity values. A Spreadsheet is available to perform the necessary calculations from these values or from NPL target SLM values. Apparent shifts in calibration values should be checked. If there is any doubt in the calibration methodology used, seek advice from NHSP. Stage A listening checks should be a component of all calibration tests.
12. Please address any queries to guy.lightfoot@nhs.net For updates visit http://hearing.screening.nhs.uk/audiology, browse to Audiological Guidelines & Protocols, Calibration & Equipment, etc, then calibration and equipment.

~ The chirps referred to here are those specified by Elberling, C., and Don, M. (2010). "A direct approach for the design of chirp stimuli used for the recording of auditory brainstem responses," See Figs 1 & 2. J. Acoust. Soc. Am. 128, 2955-2964

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