USING ISO 8253 TO CALCULATE THE MAXIMUM PERMISSIBLE BACKGROUND SOUND PRESSURE LEVELS FOR AUDIOMETRIC TESTING

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For many years, various versions of *de facto* standards have been in used in Australia for specifying acoustic conditions in audiometric test areas. These specifications had their origin in combined *Australian/New Zealand Standard AS/NZS 1269.4: Occupational noise management, Part 4: Auditory assessment*, Appendix D, *'Maximum acceptable background noise levels for workplace audiometry programs'* [1]. Although the Standard states that the *"specifications in this Standard are not intended for clinical purposes"* (pg 6), over the last few years in Australia they have been specifically used for that purpose. *ISO 8253 Acoustics – Audiometric test methods* [2] presents internationally accepted maximum permissible ambient (i.e. background, in the ANZ standards) sound pressure levels for Hearing Level (HL) measurements.

If an individual's hearing threshold measurements (HTL) are to be measured, care must be taken to ensure that it is the HTL that is measured and not the background noise of the measurement space. If a test signal is presented to a subject then in order to respond to that test signal the subject must be able to distinguish the test signal clearly from the background noise in the test space. If measuring to 0 dB (HL) is the objective then the background sound pressure level (SPL) must be significantly below the SPL of the applied test signal over the whole frequency range measured and for bands that may mask the measured bands [3].

ISO 8253 – 1, Section 11 *Permissible ambient noise*, provides internationally agreed specifications on the maximum permissible background sound pressure levels desirable for both air and bone conduction audiometry. *Table 2* of ISO 8253 – 1 provides a summary of the *"maximum permissible ambient sound pressure levels"*, L_{max}, in one-third octave bands for air-conduction audiometry to 0 dB HL using typically available supra-aural earphones. *Table 4* of ISO 8253 – 1 provides similar information for bone conduction audiometry to 0 dB HL. *Table 1* below summarises these data in octave bands.

Section 11 of ISO 8253 – 1 also indicates that by using the information supplied, the *"maximum permissible ambient sound pressure levels"* required for testing using noise attenuating headsets different to those described in the Standard and to hearing threshold levels other than 0 dB HL can be calculated in a reasonably straight forward manner.

AIR CONDUCTION

Audiometric testing using a noise excluding headset is

Octave band centre frequency (Hz)	Max permissible sound pressure levels L_{max} (Reference 20 Pa) (dB)				
	Test tone frequency range (Hz)				
	Air conduction audiometry			Bone conduction audiometry	
	125 to 8k	250 to 8k	500 to 8k	125 to 8k	500 to 8h Hz
31.5	52	62	73	47	56
63	38	48	59	30	39
125	23	39	47	17	21
250	18	18	33	11	11
500	18	18	18	8	8
1 kHz	20	20	20	7	7
2 kHz	27	27	27	6	6
4 kHz	34	34	34	2	2
8 kHz	33	33	33	9	9

Note: Using the above values provides an uncertainty of +2 dB due to ambient noise. If an uncertainty of +5 dB for the threshold value is acceptable the L_{max} values in the above table may be increased by 8 dB.

Table 1: Maximum permissible ambient sound pressure levels, L_{max}, for air and bone conduction audiometry for hearing thresholds down to 0 dB HL using typical supra-aural earphones such as the Telephonics TDH39 with MX 41/AR cushions or the Beyer DT48 (adapted from *Table 2* and *Table 4* of ISO 8253 – 1).

sometimes possible when background noise is greater than those levels specified in ISO 8253 – 1. The attenuation characteristics of the headset should come from a well recognised test procedure such as *AS/NZS 1270: 2005 Acoustics – hearing protectors* [4] where the attenuation values used are the mean attenuation minus one standard deviation. For consistency with Australian practice, the parameter L_{max} should be measured with the sound level meter on 'S' (slow) time weighting as recommended in *AS/NZS 1269.4: 2005,* Appendix B. If this is the case then the L_{max} parameter should more correctly be specified as $L_{S,max}$.

To calculate the required background levels when using a headset different from those specified by ISO 8253, the process is simply to add the extra attenuation provided by the headset intended for use to that provided by the typical specified headset. Further, if testing to a different minimum threshold is required, not to 0 dB HL, the difference between the new minimum threshold level and 0 dB HL is added to the given permissible maximum background values for 0 dB HL.

BONE CONDUCTION

HTL testing for bone conduction requires unoccluded ears, so noise excluding headsets cannot be used to reduce the background noise. However, testing to a different HL is carried out in a similar manner as for air conduction by simply adding the difference between 0 dB HL and the desired HL.

If both air and bone conduction are to be undertaken the lower background SPL requirements for bone conduction will predominate.

Using this template developed from *ISO 8253 – 1 Acoustics – Audiometric test methods – Part 1* the maximum permissible background sound pressure levels can be easily calculated to ensure satisfactory testing to the desired hearing threshold level to a specified accuracy of either +2 dB or +5 dB for both air and bone conduction.

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REFERENCES

[1] *Australian/New Zealand Standard AS/NZS 1269.4: Occupational noise management, Part 4: Auditory assessment*, Standards Australia, Sydney, 2005

[2] *ISO 8253 – 1 Acoustics – Audiometric test methods – Part 1: basic pure tone air and bone conduction threshold audiometry*, International Organization for Standardisation, Geneva, Switzerland

[3] Zwicker, E & Schorn, K (1978) Psychoacoustic Tuning Curves in Audiology, *Audiology*, 17: 120 – 140

[4] *Australian/New Zealand Standard AS/NZS 1270: 2005 Acoustics – Hearing protectors*, Standards Australia, Sydney