Decibel scales in audiology
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©BATOD Magazine November 00 page 11-12

There are a variety of decibel (dB) scales used in many applications of sound intensity measurement. In audiology the three most commonly used scales are:

- **dBSPL** (dB Sound Pressure Level) for hearing aid performance
- **dBHL** (dB Hearing Level) for pure tone audiograms
- **dBA** for sound field assessments

It is important to have some understanding of these different scales, to recognise which has been used and be able to make a comparison between different assessments that use these different scales.

**dBSPL (dB Sound Pressure Level)**

dBSPL is the scale used for hearing aid performance. Hearing aid test boxes and manufacturers’ specification sheets (hearing aid performance sheets) give measurements in dBSPL.

Sound pressure is measured in microPascals. The range of audible sound is from 20 – 200,000,000 microPascals. The dBSPL scale is a logarithmic scale representing these units in a manageable way. For each 20 decibel increase the sound pressure increases ten times. The recognised threshold of detectability at 1KHz is 20 microPascals and this is the reference 0 in dBSPL.

**Figure 1**

<table>
<thead>
<tr>
<th>MicroPascals</th>
<th>dBSPL</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0</td>
<td>1 KHz just audible</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
<td>Rustle of leaf</td>
</tr>
<tr>
<td>2,000</td>
<td>40</td>
<td>Quiet speech</td>
</tr>
<tr>
<td>20,000</td>
<td>60</td>
<td>Conversational speech</td>
</tr>
<tr>
<td>200,000</td>
<td>80</td>
<td>A shout</td>
</tr>
<tr>
<td>2,000,000</td>
<td>100</td>
<td>Pneumatic drill</td>
</tr>
<tr>
<td>20,000,000</td>
<td>120</td>
<td>Aircraft taking off</td>
</tr>
<tr>
<td>200,000,000</td>
<td>140</td>
<td>Rocket launching</td>
</tr>
</tbody>
</table>

**Figure 2**

The graph illustrates the sensitivity of the human ear across the range of frequencies used in audiology.

**Figure 3**

Printout of a frequency response curve for a hearing aid obtained using a hearing aid test box.
dBHL (Decibels Hearing Level)

The pure tone (PT) audiogram form

The pure tone audiogram form is used to record the threshold of detectability of a range of selected frequencies.

![Figure 4](image_url)

**The frequency scale**

The accepted layout for an audiogram form is shown in Figure 4. The frequencies are given at the bottom of the form, starting at a low frequency of 125Hz on the left increasing at octave intervals to high frequency 8000Hz (8KHz) on the right.

This band of frequencies has been selected as it covers the range of frequencies found in the sounds of speech.

**The decibel Hearing Level (dBHL) scale**

The figures running down the left side of the PT audiogram form (figure 4) represent the decibel scale and run from –10 dBHL at the top to 140 dBHL at the bottom.

**What is dBHL?**

Our hearing is not equally sensitive to each frequency across the speech frequency range. The human ear is most sensitive to frequencies between 500 Hz and 4 KHz.

A norm of threshold sensitivity at each frequency has been established and is indicated by 0 dBHL on the form. 0 dBHL therefore represents the threshold of detectability of each frequency for a normally hearing population, but the zero reference level varies with frequency.

The results plotted on the audiogram form are a comparison of a subject’s hearing level with the accepted norm.

A hearing level of 50 dBHL would indicate that hearing is 50dB below the norm (see fig.5). A hearing level of – 5 dBHL would indicate that hearing is 5dB better than the norm (see fig.5).
The dBA scale is used for measures of sound field assessments. Sound field assessments would include speech recognition eg Kendal Toy Test, McCormick Toy Test, Distraction Test, Manchester Junior (MJ) Word Lists, Arthur Boothroyd Lists (AB) and assessments with a warble tone generator.

When these assessments are carried out the level of the voice or sound presented is measured using a sound level meter (SLM) which has a dBA scale.

The dBA scale reflects the sensitivity of the human ear at different frequencies.

When sound field assessments are being made with for example a warble tone generator, the SLM is placed alongside the child’s ear with the microphone facing the source of the sound. When sounds are presented and the child responds the sound level is measured at the child’s ear. This figure is not necessarily the dB level indicated on the dial of the warble tone generator.

An approximate comparison of dBHL and dBA can be made by converting one scale to another. Figure 5 gives an example of a suggested conversion table. There are differing opinions on the dBA/dHL conversion figures. It would be wise to check which your Service has elected to use.

It is possible using such a conversion to plot a sound field result onto an audiogram form so that both will be in dBHL and compare for example an audiogram and aided listening results.

Suggested conversions between the different decibel scales are given in Figure 6 and can provide some guidance in making comparisons between measurements.

Sound field measurements are most usefully presented in the decibel scale on which they were measured (McCracken and Laoide-Kemp 1997).

A calibrated sound field should be used if aided responses to speech stimuli are being evaluated.


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**Figure 5**
Diagram of audiogram with 50 db flat HL and –5db flat HL

**Figure 6**
Diagram of conversion chart