INSTRUMENTATION CORNER

Single partition comparison of a PA speaker with an omni-directional dodecahedron speaker

Firstly, why would you want to do this? Decent quality PA speakers are available for a few hundred pounds, considerably less than dodecahedron speakers.

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As the Building Regulations for England & Wales (BREW) Part E Annex B testing method is still based on the now withdrawn ISO:140, the use of PA speakers is allowed (unlike the newer ISO 16283). We wanted to understand the difference between the two options and see what impact this could have on the measurement result and data.

The practical testing element of this idea was not as straightforward as we hoped! We needed to co-ordinate all the required kit and a suitable wall to test all at the same time. The office is busy that we could only book out two adjacent meeting rooms on a Friday afternoon. We also had to return some of the kit by last shipping that evening. We were against the clock which, unintentionally, made it more representative of a real-life test.

The plan was to perform identical tests as per the BREW guidance using each speaker. We had a dodecahedron speaker with matching amplifier and a Mackie SRM350 powered speaker. The measurements were done with Class 1 sound level meter and hand-held calibrator.

The meeting rooms were in the front corner of the first floor, had adjacent doors and shared a suspended ceiling. We were not expecting good results from an insulation point of view.

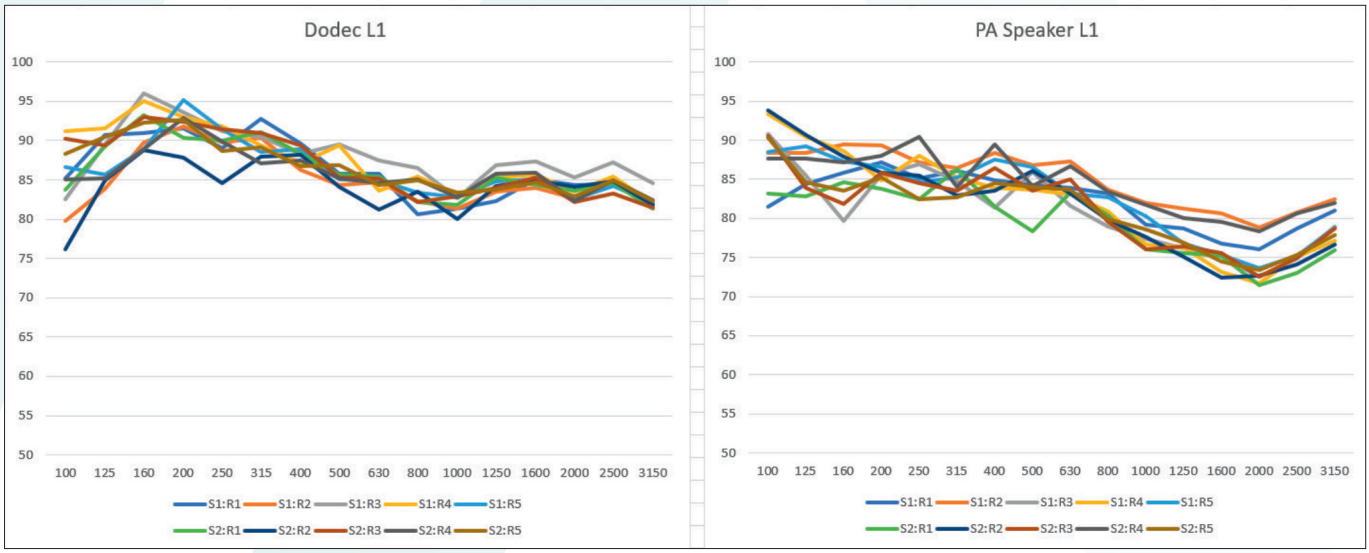
The test

Initially, we used the stationary measurement method with five discrete microphone positions for each of the two sound source positions, and took a 12 second average in each position. As the sound level meter is controlled by an iPhone App the room was empty during the measurements so there was no human absorption. We marked out the measurement and source positions on the floor to ensure consistency.

The sound level meter was placed on a lightweight tripod and moved to the next position by hand. We then left the room, shut the door and started the measurement from the App.

Below left:
Figure 1a: Dodecahedron speaker with sound level meter on tripod

Below right:
Figure 1b: Mackie PA speaker



The two speakers did not sound the same. The volumes and weights are similar but the design principals are completely different. The Mackie has one horn-loaded tweeter and a single 10" woofer (bass speaker) with two front-firing bass ports to ensure it packs a punch as a PA speaker. Ports allow low frequencies inside the box to be vented and extend the low end coming from the front of the woofer. These features are to optimise the power output rather than the linearity.

The dodecahedron speaker is a closed box with twelve mid-bass drivers pointing in 12 different directions and is optimised to produce the 100 to 3150 Hz range required in sound insulation tests; the output drops off either side of these frequencies. Closed box speakers tend to have a smooth frequency response with a gentle roll-off at the low-end unlike ported speakers which have steep cut-off below the porting frequency.

The results

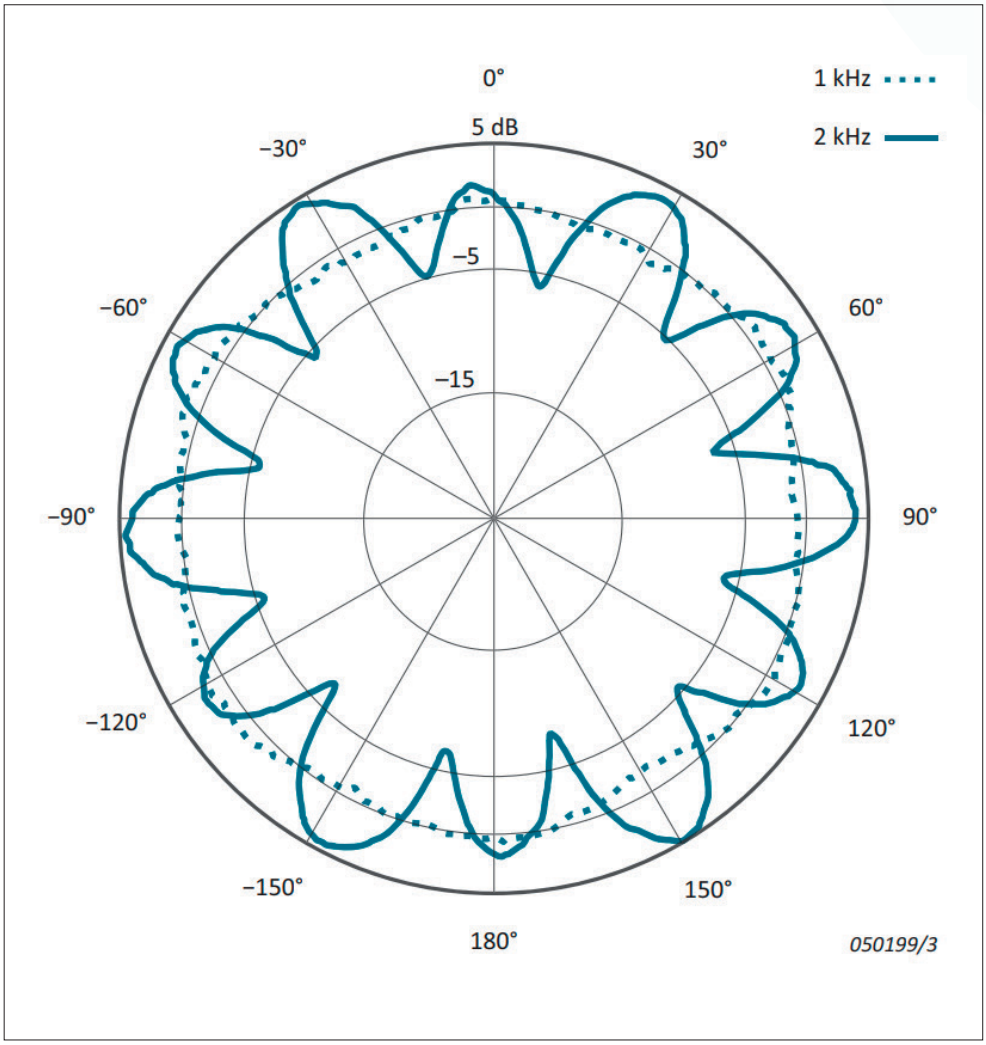
Of course, a key feature of a sound insultion test is that they are comparative measurements where the difference between the rooms is of the greatest importance. So how much difference do the speaker characterisitics make to the final result? In this example...none!

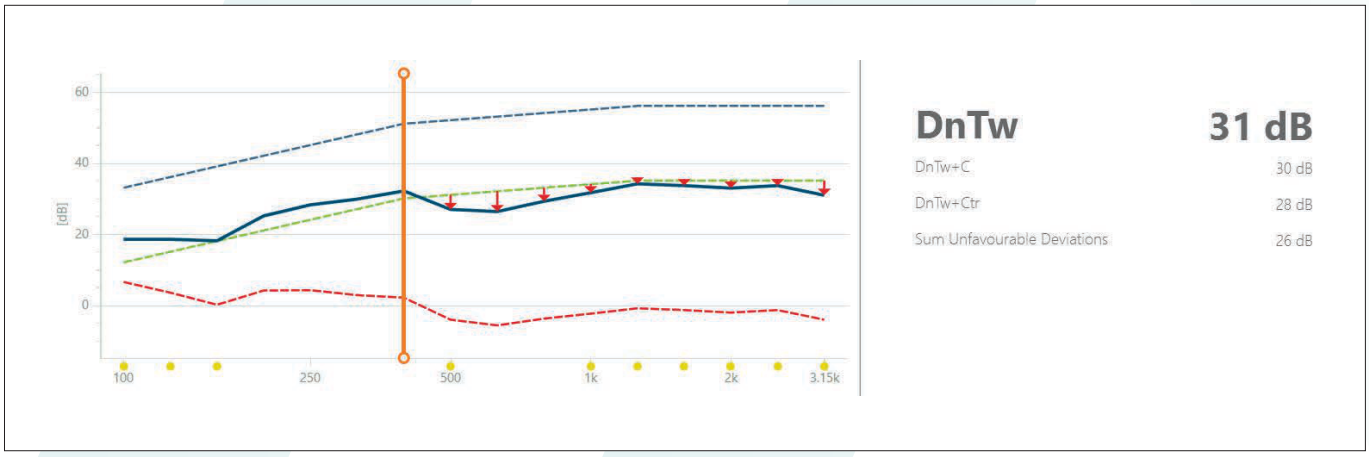
Both had a DnTw of 31dB and a DnTw + Ctr of 28 dB. A poor result for the partition, but both speakers gave the same result.

However, the sound level meter and associated software provides warnings where the measurement can be improved, and this can point us towards the differences between the two speakers. The standard deviation is a measure of variation between measurement positions. The Mackie, which has an acoustic dispersion of 90° horizontally and 80° vertically had seven standard deviation warnings in bands from 500 to 3150 Hz while the dodecahedron speaker, which is omni-directional (see Figure 3) only had three. P44

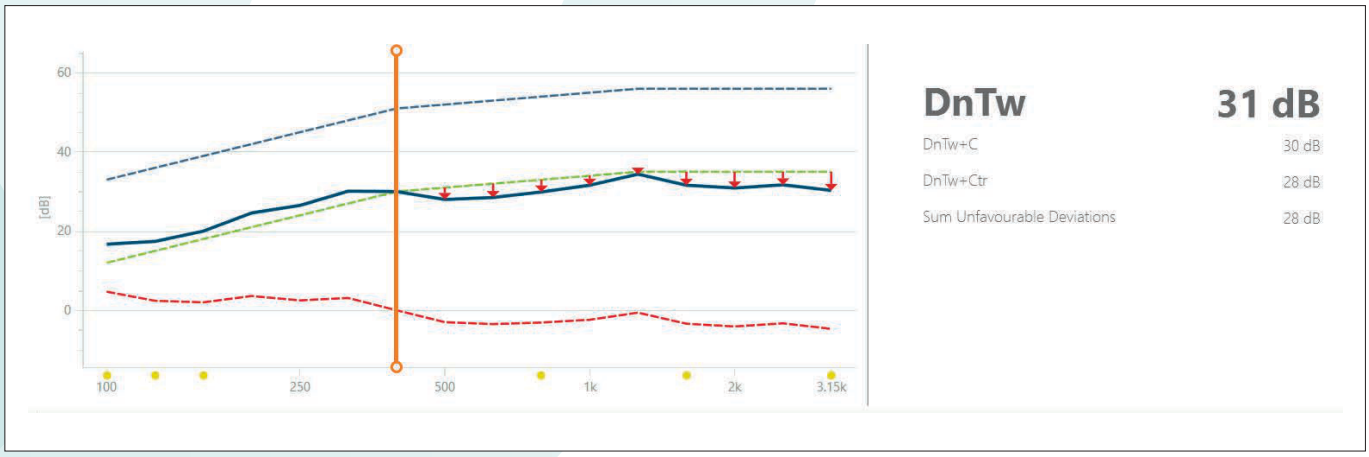
Above: The individual L1 measurements of each speaker are shown in **Figure 2**

Below: Directional response at 1 and 2 kHz of the dodecahedron speaker





Above: Figure 4: Test result using PA speaker



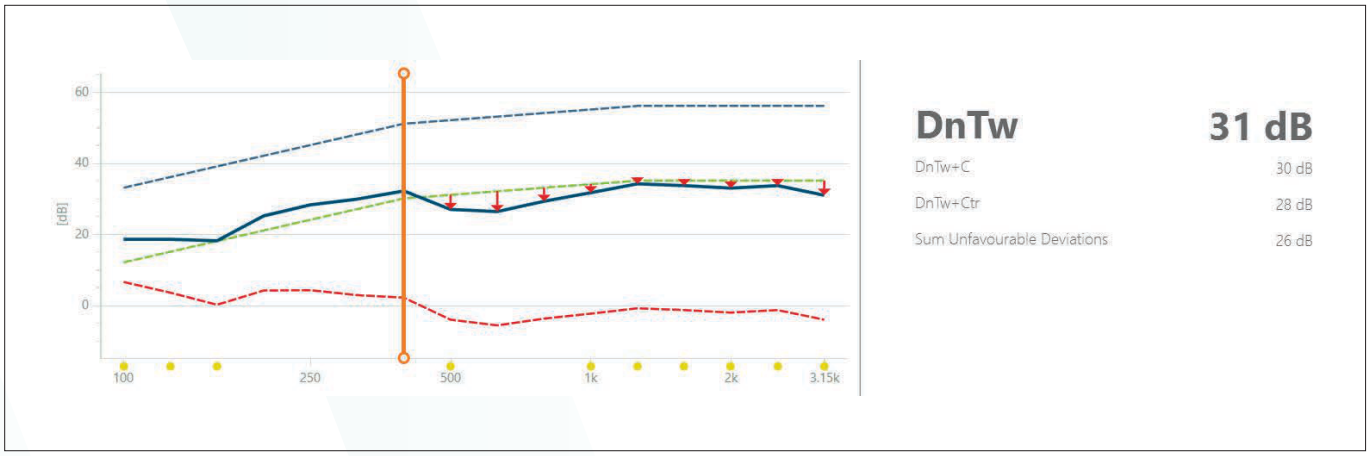
Above: Figure 5: Test result using dodecahedron speaker

The warnings which are shown as yellow dots can be seen in Figures 4 and 5.

The solid blue line is the result, the dotted blue line is BREW reference criteria, the green dotted line is the shifted curve and the red dotted line is the deviation of the result from the shifted curve.

For comparison we also used an extension rod to perform a moving microphone measurement with the dodecahedron speaker. Again, the DnTw + Ctr was 28dB. However, this method was significantly quicker than the discrete points method. We measured a 20 second sweep for each of the speaker positions. The L1(source) and L2 (receive) measurements were completed in about four minutes including moving the speaker, compared to nearly 15 minutes for the discrete points. The same method was used for all the background (B2) and reverberation time (T2) measurements. All three sets of tests had the same quality warnings for short reverb time in the three lowest frequency bands.

Above: Figure 6: Moving microphone method with extension rod



Above: Figure 7: Test result using moving microphone method with dodecahedron speaker

The conclusions

To conclude, there was not as much difference in the results as expected, but this was just one example. Further work would be beneficial to experiment with a range of room sizes, partition types and speaker orientations. We can see that in this case there is an impact from the high frequency directionality of PA speaker but it has not changed the result of the sound insulation test.

It is also worth noting that measurement equipment manufacturers will perform factory conformance tests on their speakers to ensure their specification is met. PA speaker manufacturers will usually perform quality checks but this would not have the same traceability to national standards. This could provide additional confidence in the repeatability of results.

An aside to the original remit is that the moving microphone method is a more time efficient technique than measuring discrete points. It also removes the L1and L2 standard deviation requirement from an assessment as each source position is only measured with one longer average.

Overall, this assessment was inconclusive but it has provided some excellent pointers to futures studies.