The dummy microphone is no longer alone

By Ian Campbell

Measurement of low level noise has long been a feature of environmental noise surveys, yet it is one of the aspects of instrumentation that has not been given much attention. Statistical parameters are normally used for these determinations, yet in the long-awaited revision of the sound level meter specification there is no mention as to how they should be measured. It appears you can choose the sample rate, bin size and time constant to suit your own, or the instrument designer's needs. To be fair however, as most instruments are now little computers in their own right they have all the processing power necessary and the solutions offered by manufacturers are usually more than adequate for the task. So it comes down to determining the lowest level that the instruments can measure; traditionally this has been verified during the periodic verification (calibration) by the measurement of the instruments self-noise, which is duly reported on the calibration documentation. This measurement has to date been made as a measurement of the preamplifier self-noise by replacing the microphone with a dummy microphone and noting the level indicated on the meter. These dummy microphones place a similar load on the preamplifier as a real microphone but do not have any active microphone element so you can see what the meter would indicate if the microphone diaphragm was fixed and could not move.

In the good old days the electrical noise of the preamplifier was normally the controlling factor but over the years electronics has improved and now it is not uncommon to find instruments returning self-noise figures of less than 8 dB(A). But this does not mean we can measure statistical levels down to these values as the microphone element itself has an inherent self-noise that is significantly above this level. This microphone self-noise is due to the random movement of molecules within the microphone and varies depending on the type of microphone and the degree of damping they use to produce the required frequency response. For a standard half-inch 50 mV free field measurement microphone the microphone self-noise will be around 15 dB(A). These two numbers will combine to give an effective noise floor for the instrument of 16 dB(A) so any measurement of less than 26 dB(A) has to be treated with some caution.

Fortunately, the standards have now recognised these problems and in the new version of the instrument verification standards the self-noise has to be measured with the microphone present. This is a measurement of just the dB(A) value with the other weighting networks being verified in the conventional manner. For the calibration laboratory this means that a test area has to be constructed that has a noise level ideally of less than 8 dB(A) and an instrumentation system that can measure these low levels. Fortunately, it does not have to be very large so an enclosure about a metre cube constructed with dense materials and good vibration isolation can achieve this and a special low noise monitor microphone is used to verify the levels present when the microphone and associated instrument are being checked. It gets a little more complex when you have to consider the different configurations of instrument that are presented for calibration. Some have extension cables so just the microphone has to be in the "quiet zone", but in some cases the complete instrument has to be in the test box. Then of course the problem is being able to see the display so a bit more complexity comes into play. We have even seen instruments that themselves produce noise levels due to the coils or display drivers emitting tones that are audible in the test enclosure! You soon get to the stage where you need a dual channel real time analyser to check the results; the characteristic spectrum of the microphone and preamplifier self-noise are well defined and hence measurement artefacts soon show up. Experience has shown that noisy microphones are one of the main causes of problems where L90 values have been questioned, so hopefully these problems should be captured in future before the instrumentation gets out on site.

So if your meters are calibrated to the new BS EN 61672 standard there should be an extra line on the calibration report that gives the dB(A) self-noise for the microphone in addition to the electrical noise on all the frequency weightings. Then for sure you know how low you can go.

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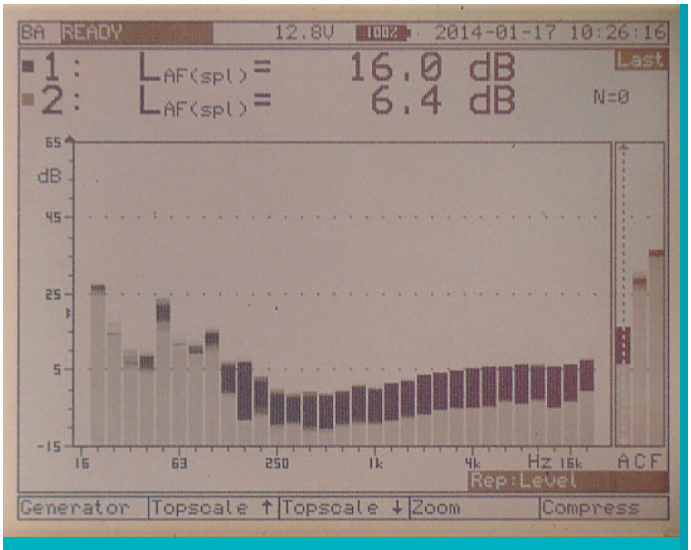

Microphone self-noise measurement
Channel 1 is the device under test and channel 2 the monitor microphone verifying the noise level in the test chamber. Results <250 Hz are preamplifier/ambient break through noise and > 250 Hz are microphone noise