

Are old timers past their peaks (L_{Cpk} that is)?

By Ian Campbell

For many years now the Noise at Work Regulations in the UK have set specific maximum limits for peak C weighted sound pressure levels that employees and contractors can be exposed to; there has also been a revision of the regulations that have reduced these permitted peak exposure levels. Over these years there have also been many design improvements in sound level meters and even a complete revision of the standards that these instruments have to comply with. However there are still many old instruments being used to determine compliance with the revised regulations. This has prompted a quick look back to see how some of these “legacy” sound level meters would perform in today’s litigious environment.

The first problem would be to consider the type of waveforms that can give rise to these high peak values; these can arise from many different sources ranging from percussive impacts to

cartridge fixing tools. It follows therefore that they can have very different waveforms that are as much due to the initial event as the acoustic environment in which the subject is working at the time of the risk assessment. In order to characterise the performance of an instrument it would be necessary to specify a standard test waveform that would be used to perform a test. It is in this area that the standards have changed, although consideration was given to the backwards compatibility of the standards during the revision.

The initial standards for sound level meters go back into the previous century and in their final version were contained in BS EN 60651 and 60804 standards and these described type 0, 1, 2 and 3 meters. All of these variants had similar nominal values but with widening tolerances as the type number increased. As far as peak measurements were concerned they were only mandatory



in type 0 instruments and hence the standard contained a test to confirm that these peak measurements were correct. These type 0 meters were very rare beasts indeed and only a few manufacturers actually made any of these “Laboratory Standard” meters. The Noise at Work Regulations specified type 1 or 2 instruments may be used to make these peak measurements as they are far more practical for field measurements. As a result type 1 and 2 instruments were produced with “optional” peak measurement modes. When it comes to the legal metrology considerations of using these instruments the BS 7580 standard specified the regular laboratory verifications that would be required. This standard had to accept that as peak measurement was not specified for these type 1 and 2 meters a meter could be certified to the standard as type 1 or 2 if its peak measurement mode did not work as the standard does not require it to be tested. So BS 7580 states that if a peak measurement mode was provided it must be tested to the peak test as set out for the type 0 instruments. If it failed a note must be made on the certificate to confirm that the meter complies with the standard but that it is not suitable for peak sound level measurements. The standard test was to compare the difference between a 10 ms reference

square pulse and 100 μ s test pulse in both +ve and -ve directions with a limit set of < -2 dB difference in either polarity. So risk assessments made using any of these legacy sound level meters needs to be reviewed to check the calibration certification to ensure that the peak function has been tested to confirm that it was measuring correctly.

It is interesting to note that the test was made with a signal that could not possibly be produced by a microphone, so in the revision of the standards the tests were changed to use a single cycle of 8k Hz sine wave and +ve and -ve half cycle of 500 Hz sine waves. In theory the tests are quite different and hence depending on the design of the instrument could give different results. To check this out a 15-year-old meter originally manufactured to the BS EN 60651 and 60804 standards was tested to both the old and new tests. The meter in question has an independent pattern evaluation certificate so is typical of “first division” meters in current use but it should be noted that there are many instruments of this age in use that have never had any independent test to confirm that they actually meet the standards claimed. These tests were repeated five times and a repeatability calculated. The average of the five tests are shown in the tables below. P24 ▶

Pulse duration	Pulse polarity	Reference value, dB	Measured dB	Tolerance dB	Error, abs dB	Error relative
10 ms	+ve	109.00	109.16	2.00	0.16	-1.46
100 μ s	+ve	109.00	107.70		-1.30	
10 ms	-ve	109.00	109.10	2.00	0.10	-1.26
100 μ s	-ve	109.00	107.84		-1.16	

◀ P23

Average of the five tests to the old standard.
The uncertainty due to repeatability of the relative error was 0.1 dB.

Note the reference level reads around 0.1 dB higher than it should

Pulse			Level, dB				
Polarity	Type	Hz	Reference, dB		Measured value	Limit	Deviation
			RMS	Peak			
-	1 cycle	8000	126	129.4	128.06	2.4	-1.34
+ve	½ cycle	500	129	131.4	130.44	1.4	-0.96
-ve	½ cycle	500	129	131.4	130.3	1.4	-1.10

New BS 61672 Ed1 Peak Test on Legacy Sound Level Meter

Average of the five tests to the new standard.
The uncertainty due to repeatability of the 8k Hz error was 0.22 dB and of the 500 Hz half cycle 0.1 dB.
It appears that the meter passes both tests and with similar deviations from the nominal values. Both can therefore be used to make peak noise risk assessments but it is worth bearing in mind the fact that readings are around 1 dB lower than the nominal value expected.

analogue technology, now of course this has been replaced by digital methods of processing the signal. To look at the difference that this would make a more modern version of the same meter that has a fully digital method of capturing and storing the peak values was also tested to the new standard and its results are shown in the final table. In this case digital implementation of the peak circuits halves the errors and also brings about improvements in the measurement uncertainty.

These legacy sound level meters make extensive use of

Pulse			Level, dB				
Polarity	Type	Hz	Reference, dB		Measured value	Limit	Deviation
			RMS	Peak			
-	1 cycle	8000	126	129.4	128.66	2.4	-0.74
+ve	½ cycle	500	129	131.4	131.3	1.4	-0.10
-ve	½ cycle	500	129	131.4	131.3	1.4	-0.10

New BS 61672 Ed1 Peak Test on Modern (Digital) Sound Level Meter

Replacing analogue electronics with digital capture and storage for the peak circuits

The uncertainty due to repeatability of the 8k Hz was 0.1 dB and the 500 Hz 0.0 dB

Going back to the legacy sound level meter tested it would appear as long as due allowance is made for their age there is no reason why these older meters should not continue to be used for these risk assessments. However, care needs to be taken to ensure that these older meters have had their peak performance correctly evaluated in accordance with the requirements of BS 7580; and if so old analogue meters can be used alongside their modern digital equivalents with adequate precision for determining L_{Cpk} values.

However bear in mind that these comments are based on tests on one single instrument taken from our equipment cupboard at random. Note this meter has pattern evaluation certification and has been kept in calibration for all of its working life; as such it is an example of an instrument from the "top draw". There are many legacy instruments out there that have not had any independent audit to confirm compliance with the measurement standards and hence may struggle to provide results that conform to the requirements of the Noise at Work Regulations. Results given here are therefore intended to give an example of how things may have changed over the life of the Noise at Work



Regulations and each individual case has to be considered on the merits of the data available. ◻

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