Can I believe a peak reading from a dosemeter?

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Dosemeters are often used to assess noise exposure. We also frequently see surprisingly high peak levels reported from dosemeters in risk assessments. In a recent series of measurements we observed inexplicable high peak readings in our own measurements. I tested the dosemeters used and found that one had an intermittent fault, which generated spurious peak readings. Having eliminated that one, I then extended the testing to see whether dosemeters, confirmed to be working within specification, had provided reliable peak indications.

I took three noise dosemeters (two of one model and one of another), each meeting the dosemeter standard (BS EN 61252) and compared their response with microphones and instrumentation meeting the sound level meter standard (Class 1 BS EN 616172-1). When the dosemeters and other instrumentation were tripod mounted they gave similar C-weighted maximum peak sound pressure level (Cpeak) readings for a range of impulsive noises. But when the dosemeters were mounted on the body, on the shoulder, the dosemeter peak readings were higher by 1 to 3dB. This increase is not a fault but due to the dosemeter being in the disturbed sound field around the subject's body. Mounting on the body increases the uncertainty associated with dosemeter measurements.

Physical activity and handling of the dosemeter are also often said to be causes of error or uncertainty. I tried a good five minutes energetic skipping while wearing dosemeters, pulling heavy outdoor clothing on and off, and roughly removing and refitting the dosemeter. No dosemeter gave a peak reading above 106dBC, which is quite insignificant when you compare it to the 135dBC lower peak action value in the Control of Noise at Work Regulations.

However tampering with the dosemeters did cause significant peak readings. Singing directly into the microphone gave peak readings above 120dBC; a few heavy taps on the microphone (with the windshield still fitted) gave over 130dBC; and blowing over the microphone, without the windshield, gave up to 138dBC. Other people have recommended making dosemeter measurements over several days and only using the later results when the novelty factor and hopefully the incidence of tampering have reduced.

Perhaps the most critical factor affecting the uncertainty of dosemeter readings is that dosemeter measurements are unsupervised. A competent person with a sound level meter will avoid measuring near a compressed air jet, avoid physical contact with the noise source and is wary of measurements in the very near field of a source. However, dosemeter measurements are largely uncontrolled.

So how do dosemeter and sound level meter measurements in the real world compare? I analysed noise measurements made in seven printing works using a Type 1 sound level meter meeting the older standards of BS EN 60804 and BS EN 60651, and shoulder-mounted dosemeters meeting BS EN 61252. Figure 1 plots all 378 spot sound level meter readings (a mix of mostly 1 minute readings and some 30s readings), and 3398 one minute logged dosemeter readings as a cumulative distribution. In this Figure the percentage of readings (Y-axis) exceeding a sound level in dB (X-axis) is shown. Data plotted are the sound level meter and dosemeter Cpeak and L_{Aeq} readings. Under-range dosemeter results (below 70dB L_{Aeq} and 103dB Cpeak) have been included, but no sound level has been assigned to them.

In Figure 1 the L_{Aeq} distributions are shown in blue (dark blue for the dosemeter, light blue for the sound level meter): the Cpeak distributions are shown in pink and red (pink for the sound level meter, red for the dosemeter). P20

◀ P19 Figure 1 shows the sound level meter and the dosemeters have produced different result distributions. The sound level meter L_{Aeq} results are higher than the dosemeter results. More detailed analysis showed the workers wearing the dosemeters were spending time in both noisy and quiet areas, whereas the sound level meter operator took more readings in the noisier work areas. Conversely the Cpeak readings from the dosemeters tend to be higher than the sound level meter readings indicating the dosemeters have measured a more variable sound, not just across but also within the one minute logging periods.

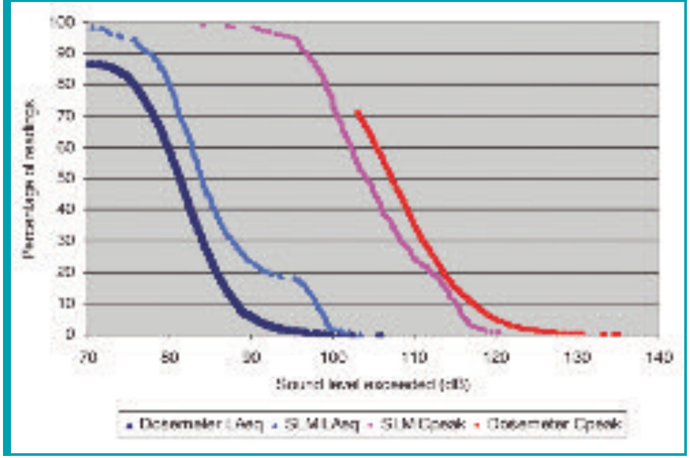
Increased variability increases the spread of values and hence the relative magnitude of the maximum values relative to the mean. Increased variability is a partial explanation for the higher peak sound pressure levels reported by the dosemeters, but the exact cause of the variation is unknown.

The kink in the sound level meter L_{eq} results between 90 and 100 dB is due to one site being significantly noisier than the other six. The dosemeter results instead show a smooth, almost gaussian, curve. The detail of the noisier site appears lost. Analysis of the individual dosemeter results confirmed the workers at this site were spending most of their time away from the noisy areas.

So how did we interpret and use the peak readings from our dosemeters? The dosemeters clearly provided useful information on the effect of behaviour and work patterns on actual noise exposure but we knew they also have a higher degree of uncertainty. We decided the peak readings reported for the print works were not a serious problem. The highest of the 378 maximum Cpeak readings recorded by the sound level meter was 120dB; the maximum out of the 3398 dosemeter Cpeak readings was 135dB. So both the sound level meter and dosemeter results indicated that health risks from the peak sound pressure levels were unlikely.

But what should you do when you get an unexplained and possibly excessive maximum Cpeak result from a dosemeter? Faults aside, we expect dosemeters to give similar readings to other instrumentation when in the same sound field, but when worn on the body readings are prone to increased measurement variation and uncertainty. Increased variation will nearly always cause maximum Cpeak values to err on the high side. So if the Cpeak values recorded are less than the lower action value of 135dBC (Control of Noise at Work Regulations 2005) without overload, you have shown that the peak lower action value was not exceeded during the measurement period. f peak levels measured are above the 135dBC lower action value, or you are unsure because overload has occurred, you should check again with a sound level meter. Try to identify the likely source of the sound and take any necessary action to protect those at risk.

Figure 1 L_{Aeq} and Cpeak cumulative distribution for sound level meter and dosemeter measurements in the printing industry



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