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dedicated to noise measurement

Noise Measurement 3

Advice when choosing noise measurement equipment for Noise at Work

Noise legislation, designed to protect hearing and prevent noise nuisance, is becoming tougher and more widespread. It's a response to our increased understanding of the damage that noise can do to hearing, and the negative impact it can have on quality of life in the wider community. It has resulted in a growing need to measure noise and rising demand for noise measurement equipment.

However in order to gather accurate and meaningful information about noise levels in your workplace, or the impact you might be having on your neighbours, it is essential that you invest in the right measurement equipment for the task in hand. This article aims to provide advice on how to choose the best noise measurement tools for your application, and outlines one or two issues for consideration after the equipment has been purchased.

Choosing a noise measurement instrument

Noise measurement instruments, and Sound Level Meters in particular, can vary hugely in cost as well as in complexity. It is possible to find instruments, usually via the Internet, Internet, for little as £20 and it is possible to spend well over £5,000 on a sound level meter. Deciding which to buy can therefore be confusing, and expensive if the wrong choice is made.

A simple instrument may require less training to operate, but might not give the measurement parameters needed.

An expensive instrument may provide the data required, but the level of training and understanding needed to use it could turn it into an expensive bookend.

Although there are many professionals who are using noise measurement instruments every day, the majority of users are those for whom noise is just a part of their jobs.

For this type of user, there is a strong case to be made for choosing an instrument that meets the practical requirements of any regulations, standards or guidelines whilst keeping the instrument as simple as possible.

Before choosing a supplier or instrument, consider a few points.

What measurements are required?

As a rule of thumb, the more expensive the Sound Level Meter, the more functions the instrument will provides.

However, these functions should not get in the way of making the noise measurements needed to comply with regulations and guidelines.

The level of training and experience required to operate complex Sound Level Meters can often get in the way of making good quality noise measurements.

For example, the Control of Noise at Work Regulations 2005 requires the following measurements for compliance:

1. The equivalent continuous A-weighted sound pressure level (L_{Aeq})

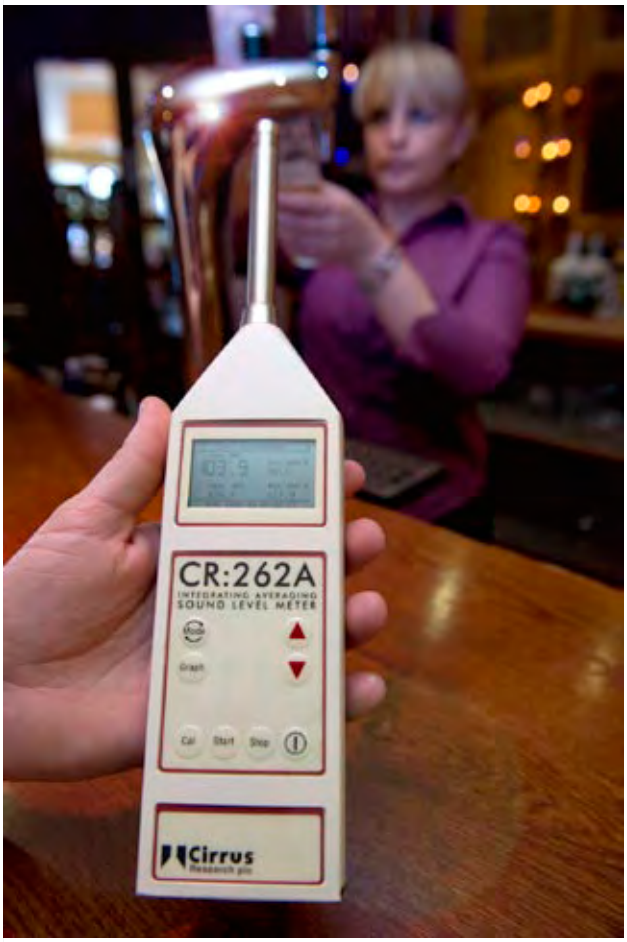
2. The maximum C-weighted peak sound pressure level (L_{CPeak})

There may also be a need to measure other metrics such as the equivalent continuous C-weighted sound pressure level (L_{Ceq}), or the L_{eq} in octave frequency bands, if there is a need to provide suitable hearing protection, but the basic measurements needed are the L_{Aeq} and L_{CPeak} values.

Most Sound Level Meters that can provide these measurements will also be able to display the basic Sound Level, which can be useful for quick noise level checks.

As sound level meters become more sophisticated, other functions will be available in addition to these two basic parameters.

These may be useful for other measurement applications and to deal with more complex noise risk assessments. One of the most useful of these additional functions is data



logging or storage of measurements in the instrument. Downloading measurements to a software program allows measurements to be stored for later reference, to be used in risk assessment reports or for more details analysis and noise exposure calculations.

It is becoming increasingly common for those responsible for occupational noise measurements also to be charged with the recording of environmental noise.

So an instrument that provides additional measurement parameters such as L_{max}, L_{10} and L_{90}, may be appropriate provided of course that the user understands the difference between these functions and those required for occupational noise measurements.

And I would stress once again that for occasional users, an instrument which provides a large number of functions and features may not be the best solution, due to the high degree of training and understanding required.

Noise Dosemeters

Measurements made using a Sound Level Meter would typically be short term L_{Aeq} and L_{CPeak} values which would then be used to calculate a daily or weekly exposure value in terms of an $L_{AEP,d}$ or $L_{EX,8h}$.

However, there are many situations where using a handheld Sound Level Meter is not possible for both practical and safety reasons.

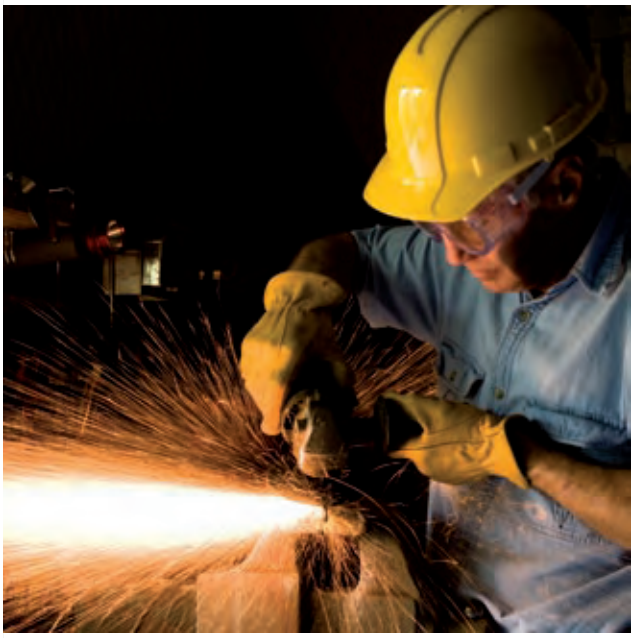
For example, assessing the noise exposure of fork lift truck drivers or employees with complex working patterns would be problematic using a sound level meter and this is where a noise dosemeter becomes the ideal measurement tool.

A major advantage of using a noise dosemeter is that if they are worn for the whole working shift, then the noise dose will have been measured in full and no further calculations will be required.

Noise dosemeters typically measure both the overall L_{Aeq} and L_{CPeak} values as well as calculating the daily exposure value in terms of $L_{AEP,d}$ or $L_{EX,8h}$. One of the most useful features that a noise dosemeter can provide is a display of the noise level throughout the day.

Although the overall noise exposure is the most important data, and the one that is used to check against any regulations and noise limits, being able to see the times when the noise was high and to be able to identify unusual or unexpected noise levels can be vital in understanding the pattern of noise recorded.

"noise dosemeters are often capable of measuring noise to a number of different regulations which may require very different configurations"



For example, the Control of Noise at Work Regulations 2005[1] which is in force in the UK uses a 3dB Exchange Rate (Q) and requires no threshold time weighting to be used, whereas the OSHA Regulations[2] in force in the US, as well as a number of other countries, uses a 5dB Exchange Rate, an 80dB Threshold and Slow time weighting.

Whilst these may seem to be relatively small differences, they can produce significantly different results.

As an example, the following measurement was taken at an American Football game. Noise levels were recorded in accordance with the UK and US methods and although the noise level was the same, the information presented by the noise dosemeter was very different:

EU Configuration		US (OSHA) Configuration	
$L_{Aeq,t}$	92.6 dB(A)	L_{AVG}	88.9 dB(A)
$L_{EP,d}$	92.1 dB(A)	TWA	88.1 dB(A)
% Dose	511%	% Dose	75%

The most obvious difference is that the US OSHA configuration records the noise exposure as 75% of the daily level whilst the UK configuration records the same noise as being 511% i.e. over 5 times the daily exposure limit.

It is vital therefore to ensure that if a noise dosemeter is to be used, that it has been configured and calibrated correctly so that you record the measurements you need.

What accessories are required?

It is always advisable to purchase a sound level meter or noise dosemeter as a complete kit. This typically contains the instrument, a suitable acoustic calibrator, a windshield and a protective carrying case.

By purchasing a kit, you will have all of the accessories needed to use the equipment in the way specified by the manufacturer.
One of the most important accessories is an acoustic calibrator. Without this, the noise measurement instrument cannot be calibrated and therefore any measurements made would have to be considered questionable. All noise measurement standards, regulations and guidelines will state that an instrument must be calibrated before and after each use.

"using a sound level meter and an acoustic calibrator from different manufacturers should be avoided wherever possible."

Acoustic calibrators are designed to work with specific microphone capsules and using a combination of units from different manufacturers can introduce unknown errors to the calibration of the instrument.

As the microphone capsule on the instrument is the most delicate part and is easily damaged, special care should be taken when carrying a sound level meter. It is common for microphone capsules to cost many hundreds of pounds and so damaging this part of the instrument can be very costly indeed.

Using the windshield supplied with the instrument, even when the measurements are being made indoors, will help to protect the microphone from accidental damage.

Noise dosemeters are usually more robust as their microphone capsules are either housed inside the instrument or are protected by a windshield or cover.

This helps to protect the unit from damage as well as stopping dust and other contaminants getting on to the microphone.

Again, as with Sound Level Meters, it is advisable to purchase a dosemeter as a complete measurement kit which would include the accessories needed.

Does the equipment meet the required standards?

The performance of sound level meters, noise dosemeters and acoustic calibrators are set out in national, European and international standards.

These standards are produced initially through the International Electro-technical Commission (IEC), before being adopted as European and then as National Standards.

For example, the current standard for Sound Level Meters is IEC 61672-1:2002. This has been adopted as a European Harmonised standard, an EN, which is then adopted as a British Standard with the title BS EN 61672-1:2003.

The date at the end of the standard shows when it was adopted and this may be different from the original IEC standard. Similarly, the IEC standard is adopted in Germany as a DIN-EN standard, France and as NF-EN standard and Spain as an UNE-EN standard.

The table below shows the current standards for Sound Level Meters, Integrating Sound Level Meters (i.e. those that measure L_{eq}), Noise Dosemeters and Acoustic Calibrators which apply in the UK.

Instrument Type	Current Standards	Superseded Standards
Sound Level Meter	BS EN 61672-1:2003 Also published as IEC 61672-1:2002	BS EN 60651 BS 5569:1981 IEC 60651:1979 (previously known as IEC 651)
Integrating Sound Level Meter	BS EN 61672-1:2003 Also published as IEC 61672-1:2002	BS EN 60804:2001 BS 6698:1986 IEC 804:1985
Noise Dosemeter	BS EN 61252:1997 Also published as IEC 61252:1993	BS 6402:1994 (Previously numbered as IEC 1252:1993 and BS 6402:1994)
Acoustic Calibrator	BS EN 60942:2003 Also published as IEC 60942:2003	BS EN 60942:1998 IEC 60942:1997

How accurate is a Sound Level Meter?

This is a difficult question to answer. Within the standards are many specification points, requirements and tolerances.

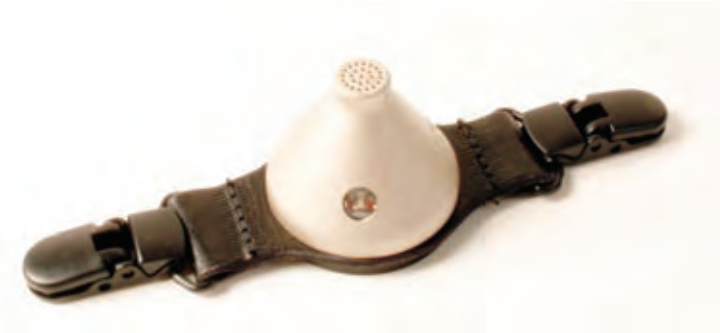
The latest Sound Level Meter standard gives two levels of accuracy, Class 1 and Class 2 which have replaced the previous Type 1 and Type 2 tolerances.

It is usually sufficient to say that an instrument is Class 1 or Class 2 rather than looking for a percentage or dB figure to quote.

If a noise measurement instrument, such as a Sound Level Meter, is to be used to meet the requirements of a measurement standard, then it is likely that the standard specifies what Class or Type of instrument is suitable.

The Control of Noise at Work Regulations 2005 which are in force in the UK states the following with regard to Sound Level Meters: *"Your sound level meter should meet at least Class 2 of BS EN 61672-1:2003 (the current instrumentation standard for sound level meters), or at least Type 2 of BS EN 60804:2001 (the former standard)."*

Noise Dosemeters



Personal Noise Dosemeters have their own standard with which they must comply and these are different to those required for sound level meters.

This standard, IEC 61252:1997 has just one level of accuracy and so noise dosemeters have no Class or Type associated with them. If a noise dosemeter is quoted as having a Class or Type, then this is for compliance with standards other than the Noise Dosemeter standard.

The Control of Noise at Work Regulations 2005 which are in force in the UK states the following with regard to Noise Dosemeters: *"Your dosemeter should meet the requirements of BS EN 61252:1997."*

Acoustic Calibrators

The calibration of all noise measurement equipment using an acoustic calibrator is a very important part of making measurements and ensuring that the data gathered is as accurate as possible.

As with the actual noise measurement instrument itself, an Acoustic Calibrator must meet the requirements of a standard.

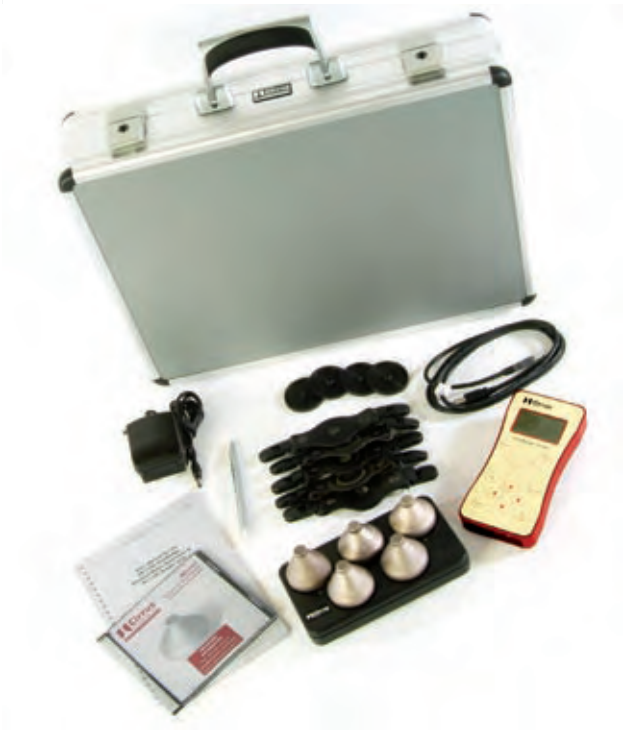
"the calibration of all noise measurement equipment using an acoustic calibrator is a very important part of making measurements"

Again, the Control of Noise at Work Regulations 2005 which are in force in the UK states the following with regard to Acoustic Calibrators: *"Your calibrator should meet at least Class 2 of BS EN 60942:2003."*

Can the equipment be serviced and recalibrated?

One aspect of noise measurement that is often overlooked is the question of service and calibration. All measurement standards, regulations and guidelines require that an instrument is calibrated before and after each use using an Acoustic Calibrator.

For example, the Control of Noise at Work Regulations 2005 states that *"A sound calibrator should be used to check the meter each day before and after making measurements"* as well as *"Some meters have an internal electronic calibration. The internal calibration only checks the instrument's electronics and does not provide a check of the microphone."*



The accuracy of low cost noise measurement instruments can vary dramatically with ±2dB often quoted as the accuracy.

Calibrating this level of sound level meter also using a low cost acoustic calibrator with ±1dB accuracy could allow the instrument to be 3dB away from the true noise level. Using this type of Sound Level Meter without calibrating it first would introduce an unknown level of error.

Calibration & Recalibration

Noise measurement instruments are precision tools and the level of accuracy required from them is very high. Manufacturers spend considerable time and effort to ensure that their instruments meet these standards. Calibration and recalibration are an important part of using a noise measurement tool.

Every noise measurement instrument should be calibrated both before and after every measurement and also on a regular basis by an external sound source. A good quality Sound Level Meter should be either sold with a suitable Acoustic Calibrator or one should be available from the manufacturer.

The certificate of calibration supplied with any noise measurement instrument will state the standards to which it has been designed. In addition to this, instruments must also be clearly marked with the information showing the Standard and Class (where appropriate) that the unit meets.

"a good quality Sound Level Meter should be either sold with a suitable Acoustic Calibrator or one should be available from the manufacturer"

If an instrument is supplied either without a certificate of calibration from the manufacturer or, where there is a charge for a calibration certificate, then this should be viewed with caution.

An instrument produced by a reputable manufacturer, and especially one which meets the latest standards, will have been calibrated and verified and so this information should be provided, as standard, with the instrument. This applies to all types of noise measurement equipment.

If this is not the case then the question should be asked "Does this instrument meet the standards that are required for me to meet my regulations and guidelines?"

Two questions that are commonly asked are:

"If I use an Acoustic Calibrator to check my meter every time it is used, why do I need to have it recalibrated?"

"Why do I need to calibrate my meter each time it is used if it is supplied to me already calibrated?"

If a Sound Level Meter, Noise Dosemeter or Acoustic Calibrator is to continue to provide the same performance that it did when it was new, regular servicing and recalibration is essential.

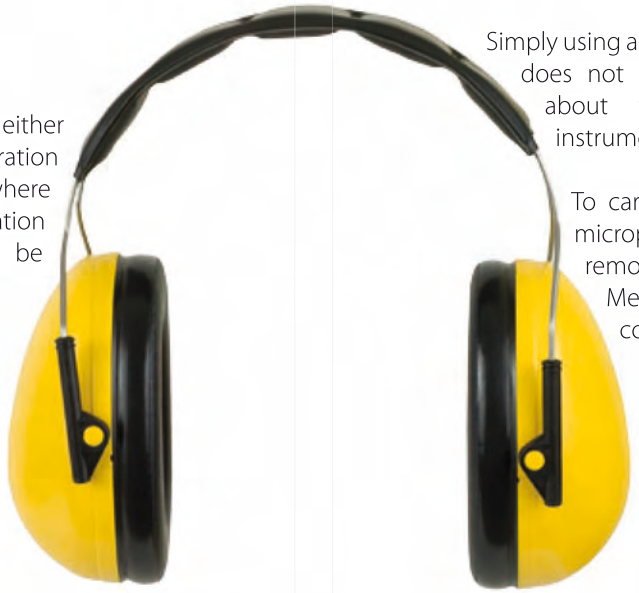
The calibration information supplied with a new instrument states that at a point in time, usually at the end of the manufacturing process, the instrument was verified and that it met the specifications claimed.

Noise measurement instruments are sensitive and knocks, impacts or tampering can affect the measurements and over a period of time.

Components such as the microphone for example can alter in their performance over long periods.

Regular servicing and recalibration can help in monitoring these issues and ensure that the equipment continues to operate reliably and accurately.

When an instrument is recalibrated, the performance of both the microphone and the electronics of the instrument should be checked against the original specifications and standards.



Simply using an Acoustic Calibrator to do this does not provide enough information about the performance of the instrument.

To carry out a full verification, the microphone capsule must be removed from the Sound Level Meter and this is often where low cost instruments fail.

Many low cost instruments have microphones which cannot be removed and so cannot be subjected to a full calibration. As the

microphone capsule is probably the single most important part of a sound level meter or noise dosemeter, this type of calibration should be considered as insufficient and possibly inaccurate.

The standards to which the instruments are designed contain many pages of tables, equations and requirements and instruments should be tested against these specification points or to another relevant procedure.

Recalibration of noise measurement equipment should be carried out either by the original manufacturer or by a suitable accredited or qualified calibration laboratory. If the user chooses not to use the manufacturer to carry out this recalibration, then the laboratory chosen must be able to calibrate noise measurement equipment to the requirements of the standards involved.

If in doubt, ask for information about what standards the instrument will be tested to, and request a certificate of calibration that states that the instrument was tested to the appropriate noise instrument standards.

Checklist

1. Does the instrument give the measurement functions needed to comply with any Standards, Regulations or Guidelines?

» For the Noise at Work Regulations in the UK and Europe, the essential measurements are $L_{Aeq,t}$ and L_{CPeak}

2. Is the instrument available with all of the accessories needed to operate it according to the manufacturer's instructions?

» A Sound Level Meter should be supplied with a suitable Acoustic Calibrator, Windshield and Protective Case

3. Does the instrument meet the specifications required by the Standards, Regulations or Guidelines?

From the 2005 Control of Noise at Work Regulations[1]:

» Your sound level meter should meet at least Class 2 of BS EN 61672-1:2003 (the current instrumentation standard for sound level meters), or at least Type 2 of BS EN 60804:2001 (the former standard).

» Your dosemeter should meet the requirements of BS EN 61252:1997.

» Your calibrator should meet at least Class 2 of BS EN 60942:2003.

4. Can the equipment be recalibrated and serviced according to both the manufacturer's recommendations and the requirements of any Standards, Regulations or Guidelines?

References

1. Control of Noise at Work Regulations 2005
http://www.hse.gov.uk/noise/regulations.htm

2. U.S. Department of Labor Occupational Safety & Health Administration
http://www.osha.gov/SLTC/noisehearingconservation/index.html

Further Reading & Information

Cirrus Article 1 - Meeting the challenges of employee noise measurements in the Oil and Gas Industry

The Cirrus doseBadge Personal Noise Dosemeter

The Cirrus CR:260A Series of Sound Level Meters

The Cirrus CR:800C Series of Sound Level Meters

The Cirrus Safety Officer's Noise Measurement Kits

The Cirrus Acoustic Calibrators

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