

Q&A

The Top 10 posts
from our blog

November 2012

Issue 2

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Introduction

Top 10 Blog posts of 2012

Throughout 2012 we've been posting information and answers to questions from our customers, distributors and sales team on our blog at cirrusresearch.co.uk/blog. This book contains the top 10 posts that you, our customers, have been reading and commenting on.

Some of the posts have been expanded with some additional information and links where appropriate. Some of the posts on the blog cover similar topics and so we've also combined some of these posts into one to cover a subject more widely.

You can easily stay up to date with new posts on the blog. Visit our blog and use the 'Stay informed! Sign up for our update newsletter' section on the right hand side.

You'll get a short email each time we post a new article as well as a summary of any new posts every 2 weeks. Just visit www.cirrusresearch.co.uk/blog and sign up.

Do you have any questions?

If you have any questions about noise measurement or using noise measurement instruments, let us know and we will try and find you an answer. To post a question, either email to sales@cirrusresearch.co.uk or use the 'Ask us a question' form on our blog at cirrusresearch.co.uk/blog.

Don't forget that you can call us on 0845 230 2434 from the UK or +44 1723 891655 from outside of the UK.

Chapter 1

What are octave and third octave band filters on a sound level meter?

The majority of noise measurements that are made with a sound level meter or noise dosimeter combine all of the frequencies of the noise to give a single overall number.

These measurements are usually 'A' weighted and are often referred to as Broadband measurements as they contain all of the frequencies of the noise.

When more detailed information about a sound is needed, the noise can be split into sections or discrete bands. This is usually done electronically within a sound level meter using digital signal processing.

These bands will have a bandwidth of one octave or one third octave which may be written as 1:1 or 1:3 octaves.

More advanced instruments may be able to give a narrow band analysis of the noise data. This may be an FFT (Fast Fourier Transform) or information in 1:12 octaves.

What is an octave band?

An octave band is a frequency band where the highest frequency is twice the lowest frequency.

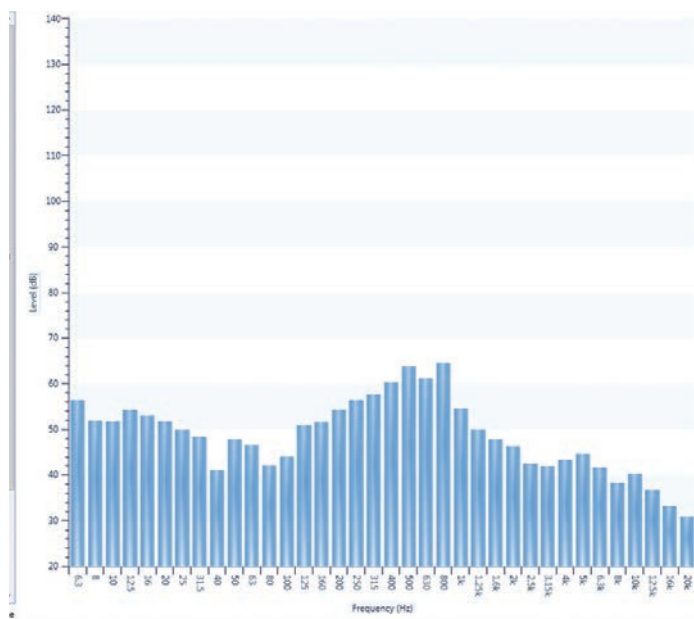
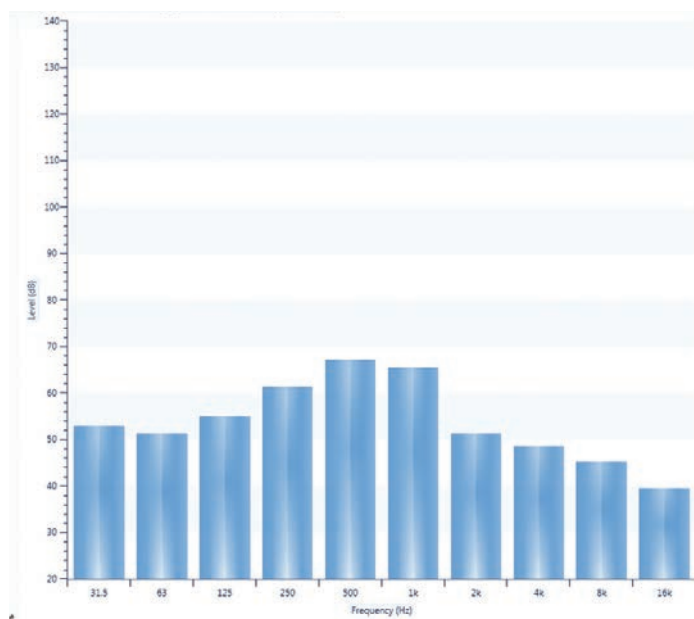
For example, an octave filter with a centre frequency of 1kHz has a lower frequency of 707Hz and an upper frequency of 1.414kHz.

Any frequencies below and above these limits are rejected.

The centre frequencies of the bands are defined in standards such as IEC 61260 - Electroacoustics - Octave-band and fractional-octave-band filters.

A one third octave band has a width of 1/3 of that of an octave band. Therefore a 1:3 octave band with a centre frequency of 1kHz would have a lower limit of 891Hz and 1122.5Hz

The following figures show the same noise level split into both octave and third octaves:



How can this help with noise measurements?

Frequency band measurements are used in a wide range of applications from selecting hearing protection, through noise control to environmental noise impact assessments.

An example of how 1:1 octave band filters can be used is in noise control.

In this application, we have two noise sources. One is a compressor and the other is a turbine.

Both of these produce a noise level of 113dB(A) when measured with a sound level meter but they sound very different due to the nature of the frequency content of their noise emissions.

The table below shows the noise levels in 1:1 octave bands from each machine (rows A & B) along with the attenuation provided by a noise enclosure (row C).

Although the overall noise produced by the two machines is the same at 113dB(A), after the same noise enclosure is fitted, the noise levels are very different.

	dB(A)	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	16kHz
A - Compressor	113.6	80	87	90	93	99	100	111	106	98	89
B - Turbine	113.6	113	122	116	116	115	97	85	60	57	42
C - Noise Enclosure	N/A	N/A	N/A	6	13	25	26	28	29	33	33
A-C	85.7			84	80	74	74	83	77	66	56
B-C	99.8			110	103	90	71	57	31	24	9

The noise level from the compressor is reduced by 28dB(A) whilst the noise from the turbine is only reduced by 14dB(A).

By using 1:1 octave band filters, we can break the noise from each machine into its component parts and it is

very clear that the turbine is producing much more low frequency noise than the compressor.

This is due to the fact that the attenuation of the enclosure is better at higher frequencies than at low frequencies. The majority of the noise produced by the turbine is in the lower frequency bands and so the noise enclosure is less effective.

The additional information provided by the frequency analysis gives an understanding of why the compressor noise is reduced by 14dB(A) more than the turbine noise. A simple dB(A) measurement may not have shown this.

This process is also commonly used when selecting hearing protection. There are many different types of ear plugs and muffs and each has its own attenuation levels at different frequencies.

By measuring the noise in each octave band and assessing this against the attenuation provided by each hearing defender, the most appropriate can be chosen for any given noise source.

Chapter 2

What are A, C & Z frequency weightings?

Your ears are most sensitive to frequencies between about 500Hz and 6kHz and less sensitive to frequencies above and below these.

To allow the sound level meter or noise dosimeter to measure and report noise levels that represent what we hear, frequency weightings are used.

These are electronic filters within the instrument that are used to adjust the way in which the instrument measures the noise.

The most commonly used Frequency Weightings that you will see on a modern sound level meter or noise dosimeter are 'A', 'C' and 'Z' and below is a brief explanation of each of these.

It is very important that you measure the noise levels using the correct frequency weighting as it is not possible to convert from one to another after the measurement has been made.

This is why a sound level meter such as the Cirrus optimus will measure all three Frequency Weightings at the same time, saving you time and removing the risk of measuring the wrong parameter.

'A' Weighting

'A' Weighting is standard weighting of the audible frequencies designed to reflect the response of the human ear to noise. At low and high frequencies, the human ear is not very sensitive, but between 500 Hz and 6 kHz the ear is much more sensitive.

The 'A' weighting filter covers the full frequency range of 20 Hz to 20 kHz, but the shape approximates to the frequency sensitivity of the human ear. So the A-weighted value of a noise source is an approximation to how the human ear perceives the noise.

Measurements made using 'A' weighting are usually shown with dB(A) to show that the information is 'A' weighted decibels or, for example, as LAeq, LAFmax, LAE etc where the A shows the use of 'A' Weighting.

'C' Weighting

'C' Weighting is a standard weighting of the audible frequencies commonly used for the measurement of Peak Sound Pressure level.

Measurements made using 'C' weighting are usually shown with dB(C) to show that the information is 'C' weighted decibels or, for example, as LCeq, LCPeak, LCE etc where the C shows the use of 'C' Weighting.

'Z' Weighting

Z weighting is a flat frequency response between 10Hz and 20kHz +/-1.5dB excluding microphone response.

Measurements made using 'Z' weighting are usually shown with dB(Z) to show that the information is 'Z' weighted decibels or, for example, as LZeq, LZFmax, LZE etc where the Z shows the use of 'Z' Weighting.

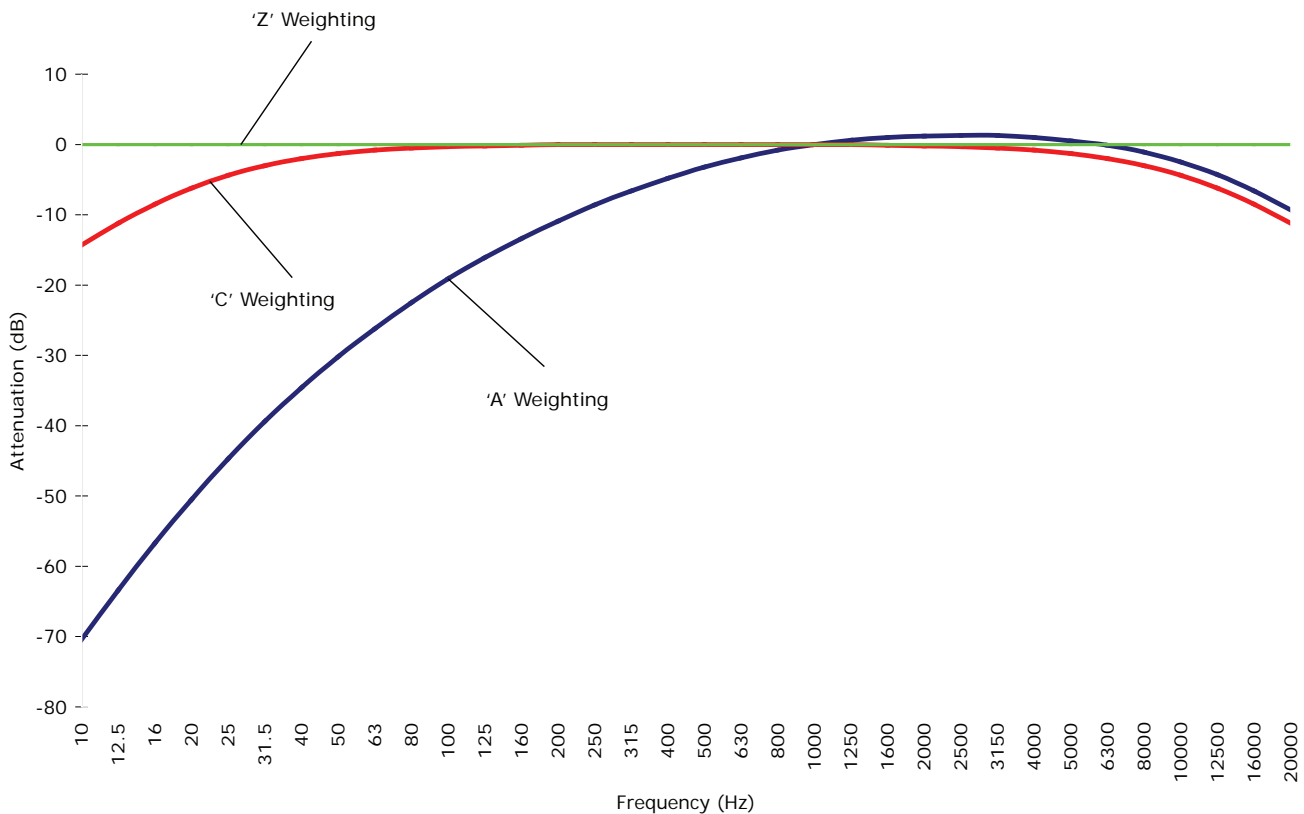
Where are these Frequency Weightings defined?

All of these frequency weightings are defined in the standards to which a noise measurement instrument is designed.

For example, the frequency weightings used on a sound level meter will be defined in IEC 61672:2003 (BS EN 61672-1:2003). This standard specifies the performance and tolerances for the frequency weighting curves to be used.

The frequency and attenuation values (relative to 1kHz) for the A, C & Z weightings are shown below.

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	16k
A-weighting (dB)	-26.2	-16.1	-8.6	-3.2	0	+1.2	+1.0	-1.1	-6.6
C-weighting (dB)	-0.8	-0.2	0	0	0	-0.2	-0.8	-3.0	-8.5
Z-weighting (dB)	0	0	0	0	0	0	0	0	0



Chapter 3

What's the difference between a Class 1 and a Class 2 sound level meter?

Instrument Standards

The standards that sound level meter manufacturers work to, such as IEC 61672-1:2002 or BS EN 61672-1:2003, define a wide range of performance criteria that instruments must meet.

These criteria are often quite technically complex and detailed and have tolerances associated with them. In the current standard, IEC 61672-1:2002, there are two levels of tolerance and these are known as Class 1 and Class 2.

In an ideal situation, the instrument would meet the centre point or design goal of these criteria exactly and every sound level meter would measure exactly the same. However, every component in the sound level meter will have some form of tolerance or variation from one component to the next.

All of the electronic components used in a sound level meter such as resistors, capacitors and even microprocessors will have very slight differences and these all add up to give each instrument its own variation from the ideal.

There are also other factors such as the uncertainty of the measurements made when an instrument is being designed or verified.

The equipment used to test a sound level meter will itself have some level of tolerance and all of these factors add up.

Because of these variations, manufacturers are allowed tolerances from the design goal. An example of this is in the frequency weightings and tolerance limits defined in IEC 61672-1:2002.

At the reference frequency of 1kHz, the tolerance limits for Class 1 are +/- 1.9dB and for Class 2 the tolerance is +/- 2.2dB.

At the lower and upper extremities of the frequency range, the tolerances are wider. At 20Hz, the tolerances are +/- 3.2dB for Class 1 and +/- 4.2dB for Class 2.

At 16Hz, the tolerances are +3.2dB, -5.2 dB for Class 1 and +6.2 dB and -∞ dB for Class 2. At higher frequencies, the same applies.

The tolerances for a Class 1 instrument are tighter at frequencies above 8kHz with the tolerances at 10kHz being +2.9dB, -3.9dB for Class 1 and +/- 6.4dB for Class 2.

At a higher frequency of 16kHz, the tolerances are +4.5dB, -18dB for Class 1 and +7.0dB, -∞ dB for Class 2.

As you can see, at the extremities of the frequency range, a Class 1 instrument must have a better response and must meet the tighter tolerances.

It is quite difficult to give a simple answer to how accurate a Class 1 instrument would be versus a Class 2 instrument as there are many different points at which they would differ, but in simple terms, a Class 1 sound level meter will need to measure over a wider frequency range than a Class 2 instrument and meet tighter tolerances for all of its performance criteria.

Which do you need?

Whether you need a Class 1 or a Class 2 instrument will depend largely upon the application that you will be using the instrument for.

As an example, the 2005 Control of Noise at Work Regulations state that a sound level meter should meet:

“at least Class 2 of BS EN 61672-1:2003 (the current instrumentation standard), or at least Type 2 of BS EN 60804:2001 (the former standard)”.

If the instrument that you were using for noise at work met Class 1 of BS EN 61672-1:2003, then it would be suitable as a Class 1 sound level meter would have a better performance specification than a Class 2 instrument.

If you are working to an environmental noise standard then this may specify that the instrument should be Class 1.

For example, ISO 20906:2009 “Unattended monitoring of aircraft sound in the vicinity of airports” states that

“..shall conform to the electroacoustical performance specifications of IEC 61672-1 for a class 1 sound level meter.”

It is always worth checking to see if that any standards, guidelines or regulations that you are looking to meet specify the Class or Type of sound level meter required.

If in doubt, please contact us and we will be pleased to help.

Chapter 4

IEC 61672 - A standard for sound level meters in three parts

Sound level meters are designed to meet a number of different performance criteria and to ensure that all manufacturers are working towards the same goal, detailed technical standards have been written and published.

Previous sound level meter standards

The classic exponential sound level meter was originally described in IEC 123 for 'industrial' meters followed by IEC 179 for 'precision' meters.

Both of these were replaced by IEC 651, later renamed IEC 60651, while the linear integrating meters were initially described by IEC 804, later renamed IEC 60804

Both IEC 60651 and 60804 included four accuracy classes, called "types". In IEC 61672 these were reduced to just two accuracy classes, 1 and 2.

New in the IEC 61672 standard is a minimum 60 dB linear span requirement and Z-frequency-weighting, with a general tightening of limit tolerances, as well as the inclusion of measurement uncertainty in the testing regime.

This makes it unlikely that a sound level meter designed to the older 60651 and 60804 standards will meet the requirements of IEC 61672. These 'withdrawn' standards should no longer be used as they have significantly poorer accuracy requirements than IEC 61672.

The current standard, IEC 61672

The current standard for sound level meters, IEC 61672, is published in three parts.

The first part, Part 1, details the performance characteristics that a Class 1 or Class 2 sound level meter should have.

Part 2 is used by test laboratories, such as the PTB in Germany, to test instruments to ensure that they do indeed meet the manufacturers claims. This is known as Type or Pattern Approval.

Part 3 details test that can be carried during a periodic verification. Below are the detailed description of each part of the IEC 61672 standard:

Part 1 - Electroacoustics – Sound level meters – Part 1: Specifications

Part 1 gives electroacoustical performance specifications for three kinds of sound measuring instruments:

- a conventional sound level meter that measures exponential time-weighted sound level;
- an integrating-averaging sound level meter that measures time-average sound level; and
- an integrating sound level meter that measures sound exposure level.

A single instrument may make any, or all, of the three kinds of measurements.

Two performance categories, Class 1 and Class 2, are specified in this standard.

In general, specifications for Class 1 and Class 2 sound level meters have the same design goals and differ mainly in the tolerance limits and the range of operational temperatures.

Tolerance limits for Class 2 specifications are greater than, or equal to, those for Class 1 specifications.

Sound level meters conforming to the requirements of this standard have a specified frequency response for sound incident on the microphone from one principal direction in an acoustic free field or from random directions.

Part 2 - Electroacoustics – Sound level meters – Part 2: Pattern evaluation tests

Part 2 provides details of the tests necessary to verify conformance to all mandatory specifications given in IEC 61672-1:2002 for conventional sound level meters, integrating-averaging sound level meters and integrating sound level meters.

Pattern evaluation tests apply for each channel of a multi-channel sound level meter, as appropriate.

Tests and test methods are applicable to Class 1 and Class 2 sound level meters. The aim is to ensure that all testing laboratories use consistent methods to perform pattern evaluation tests.

What is Type Approval?

Type Approval, or Pattern Approval, is a method where a test laboratory such as the PTB tests an instrument against a set of standard tests to ensure that it meets the performance claims of the manufacturer.

The optimum sound level meters have been designed to meet the requirements of IEC 61672 (and the corresponding EN and DIN standards) and so these independent tests have been carried out to verify that the instruments do indeed meet these requirements.

Part 3 - Electroacoustics – Sound level meters – Part 3: Periodic tests

Part 3 describes procedures for periodic testing of conventional, integrating-averaging, and integrating sound level meters conforming to the Class 1 or Class 2 requirements of IEC 61672-1:2002.

The aim of the standard is to ensure that periodic testing is performed in a consistent manner by all testing laboratories.

The purpose of periodic testing is to assure the user that the performance of a sound level meter conforms to the requirements of IEC 61672-1:2002 for a limited set of key tests and for the environmental conditions under which the tests were performed.

The extent of the tests in this part of IEC 61672 is deliberately restricted to the minimum considered necessary for periodic tests.

Periodic tests described in this part of IEC 61672 apply to sound level meters for which the model has been, or has not been, pattern approved by an independent testing organization responsible for pattern approvals and in accordance with the test procedures of IEC 61672-2:2003.

Periodic tests described in this part of IEC 61672 also apply to sound level meters for which the manufacturer claims conformance to the requirements of IEC 61672-1.

Because of the limited extent of the periodic tests, if evidence of pattern approval is not publicly available no general conclusion about conformance to the requirements of IEC 61672-1:2002 can be made, even if the results of the periodic tests conform to all applicable requirements of this part of IEC 61672.

Chapter 5

What do you need to measure for the Noise at Work Regulations?

“When making measurements to estimate the noise exposure of a person at work, you need to ascertain the equivalent continuous A-weighted sound pressure level (L_{Aeq}) that represents the noise the person is exposed to during the working day.

You also need to ascertain the maximum C-weighted peak sound pressure level or levels to which the person is exposed.”

(The 2005 Control of Noise at Work Regulations.)



The action levels described in the 2005 Control of Noise at Work regulations are given as daily (LEP,d) or weekly (LEP,w) exposure values along with peak sound pressure levels, all in dB.

A sound level meter cannot measure LEP,d or LEP,w directly as these are calculated from two other parameters which are recorded during the measurement.

These are:

- The equivalent continuous A-weighted sound pressure level in decibels that represents the sound the person is exposed to during the working day
This is commonly known as the Leq and may be shown as LAeq or LAeq,t
- The duration over which the Leq is measured

With this information, you can calculate the LEP,d using the formula given in the Noise at Work Regulations

You should also measure the maximum C-weighted peak sound pressure level:

- This will usually be displayed on your sound level meter as Peak(C) dB or LCPeak
- In accordance with the regulations, this should always be measured with C-weighting

With these two measurements for each different activity to be assessed, you can calculate the LEP,d and where required the LEP,w values.

If you need to provide PPE or hearing protection, you may also need to record additional values such as the C-weighted Leq (LCeq) or the Leq of the noise in Octave Bands.

This information can be used to assess the effectiveness of hearing protection. The optimus red sound level meters can provide these functions in addition to the LAeq and C-weighted peak values.

What do you need to measure these values?

How you make these measurements will depend upon different factors but in most noise measurements are made with either a Sound Level Meter such as the optimus red or a personal noise dosimeter such as the doseBadge.

Sound level meters

Your sound level meter should, at a minimum, be capable of measuring the Equivalent Continuous Sound Pressure Level (LAeq) and the C-Weighted Peak Sound Pressure (LCPeak)

The instrument should, optionally, be capable of measuring the C-Weighted Leq for selection of PPE using the HML method and the Octave band Leq values for selection of PPE using the Octave Band method.

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

You should be able to calibrate your sound level meter using an Acoustic Calibrator which meets the requirements of at least Class 2 of BS EN 60942:2003.

To ensure that your equipment is calibrated correctly, you should not use a sound level meter and acoustic calibrator from different manufacturers unless you have very specific information and instructions as to how these two units will work together.

Noise Dosimeters or Personal Sound Exposure Meters

A noise dosimeter may be very useful for measuring noise exposures of workers who are mobile, driving vehicles, working in environments where access is difficult or where their working pattern varies significantly and may be difficult to predict.

A noise dosimeter should measure the LAeq and LCPeak values over the measurement and be calibrated in the same way as a sound level meter before, and ideally after, each measurement.

It should also meet the requirements of BS EN 61252:1997 (Note that noise dosimeters have no class or type number).



Acoustic Calibrators

An acoustic calibrator should be used to check the sound level meter each day before and after making any measurements.

An acoustic calibrator will generate a tone at a specified level and frequency for a specified microphone.

This is the reason that you should not use an acoustic calibrator and sound level meter from different manufacturers without some very detailed and specific information.

Some sound level meters may have an internal electrical calibration. Be aware that this type of calibration does not check the microphone capsule which is the most commonly damaged part of a noise meter.

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

Cirrus recommends a CR:514 Class 2 Acoustic Calibrator for use with our Class 2 optimus sound level meters and the CR:515 Class 1 Acoustic Calibrator for use with our Class 1 optimus sound level meters.

The Reader unit supplied with the doseBadge features an acoustic calibrator that meets these specifications.



Chapter 6

Why do the standards for sound level meters have different dates?

Over the past few years, and especially since the IEC 61672 standard has been published, we've been asked to confirm if a sound level meter is marked as meeting IEC 61672-1:2002, does it also meet BS EN 61672-1:2003?

We've also been asked for why our sound level meters don't meet IEC 61672:2003 and this post will explain why there are different dates on the standards that we work to.

Instruments such as sound level meters are designed to meet certain standards and these are published by a range of International, Regional and National standards organisations.

In the case of sound level meters, the standards that we work to are usually developed and published initially by the International Electrotechnical Committee or IEC.

These are usually then adopted as a European Norm (an EN standard) and published by the European Committee for Electrotechnical Standardisation or CENELEC.

Once the European Norm has been issued it may then be adopted by the National standards organisation of each EU member country. In the UK this is carried out by the Electronic Equipment Standards Policy Committee and published as a British Standard with a BS EN reference.

This shows that the standard is the British version of the European standard. The same standard published in Germany, for example, would be a DIN EN.

There may be some time between the issuing of the original IEC version, the implementation of the EN version and then the publishing of the BS EN version and this can mean that the dates of each the standards can be different although they have the same content.

For standards that are adopted in the UK as a British Standard, the implementation usually follows:

IEC (International) > EN (European) > BS EN (British)

For example, the current standard for sound level meters is IEC 61672 and this was published in 2002 as IEC 61672-1:2002.

This standard was adopted as a European Norm and published in 2003 as EN 61672-1:2003.

This was then adopted as a British standard and published in 2003 as BS EN 61672-1:2003.

It is usual for an instrument that will be sold worldwide to be marked with the standard that is the original version.

For the optimus sound level meters, the instruments are marked as meeting IEC 61672-1:2002 although they also meet, by definition, EN 61672-1:2003 and BS EN 61672-1:2003.

Although the EN and the BS EN versions of the IEC standard may contain some additional information that is relevant to the specific country in which the standard is published (such as forewords and annexes), they will have no alterations to the original text.

Chapter 7

What Type or Class of sound level meter do I need for Noise at Work measurements?

The Control of Noise at Work Regulations 2005 require, that when you are measuring noise exposures, that you use a sound level meter or noise dosimeter that meets certain standards.

This is to ensure that the measurements are as accurate and repeatable as possible. This helps to reduce the uncertainties and potential sources of errors as much as possible.

Sound Level Meters

For the Noise at Work Regulations, your sound level meter must be able to measure, at least, LAeq,t and the Peak C-weighted Sound Pressure or LCPeak.

Additionally, it may be useful to measure the LReq and the Leq in Octave Bands. This information may be used to calculate the effectiveness of hearing protection.

This requires a sound level meter that is capable of measuring integrated noise levels as well as peak sound pressure levels.

The Noise at Work Regulations state

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

The CR:162C optimus sound level meter that we would recommend for Noise at Work measurements meets these requirements and is capable of measuring LAeq & LReq at the same time if you are looking to use the HML method as well as 1:1 Octave Bands.

Acoustic Calibrators

It is essential that any noise measurement instrument is calibrated before it is used to ensure that your measurements are accurate.

An Acoustic Calibrator is used to check that your noise instrument is measuring accurately. Note that this does not remove the need to have your equipment calibrated regularly by the manufacturer or a suitably qualified laboratory.

The standard that is currently being used for Acoustic Calibrators is BS EN 60942:2003 which is also published as IEC 60942:2003. These have superseded BS EN 60942:1998 and IEC 60942:1997 respectively. The standard has two different levels for Acoustic Calibrators, Class 1 and Class 2.

The Noise at Work Regulations state

“Your calibrator should meet at least Class 2 of BS EN 60942:2003”

The Acoustic Calibrators supplied with the Class 2 optimus sound level meters meet the requirements of this standard and therefore are compliant.

Noise Dosimeters

Noise Dosimeters are designed to meet a different standard from sound level meters.

In the UK, a noise dosimeter that is designed to be used for the Noise at Work Regulations should meet BS EN 61252:1997 or the international standard IEC 61252:1993 (these are the same thing).

This standard has no Class or Level designations and so it is not correct to say that a noise dosimeter is Class 2 or Type unless it also meets the separate sound level meter standards. Always check that a noise dosimeter does meet BS EN 61252:1997 or IEC 61252:1993.

The Noise at Work Regulations state

“Your dosemeter should meet the requirements of BS EN 61252:1993. Dosemeters have no type or class number”.

For example, the Cirrus doseBadge meets the requirements of the BS EN and IEC versions of the standard and is marked at IEC 61252:1993.

Summary

Your sound level meter should meet at least Class 2 of BS EN 61672:2003 (the current instrumentation standard for sound level meters), or at least Type 2 of BS EN 60804:2001 (the former standard) - L108, pp 92. Appendix 1, 8

Your dosemeter should meet the requirements of BS EN 61252:1993. Dosemeters have no type or class number - L108, pp 92. Appendix 1, Para. 16

Your calibrator should meet at least Class 2 of BS EN 60942:2003 - L108, pp 93. Appendix 1, Para 19

Chapter 8

Why should you use a windshield on a sound level meter?

A windshield is a very useful part of your noise measurement equipment and there are several reasons why you should use a windshield whenever you are making noise measurements.

These are:

- To reduce the effects of wind & air movement across the microphone
- To protect the microphone from damage
- To keep the microphone capsule clean

To reduce the effects of wind & air movement across the microphone

Microphone capsules are sensitive things that have been designed to react to changes in air pressure.



These changes can be very, very small when the noise levels are down to 20dB or quite large when the noise levels are over 140dB.

Making a capsule that can be sensitive across all these different levels is a challenge and makes the microphones susceptible to wind.

When you are measuring outdoors, you should use a windshield to reduce (as much as possible without affecting the results) the effects of wind upon the measurements.

The windshield that is available for your sound level meter has been designed to allow the changes in air pressure from noise through whilst reducing the turbulence that wind can create.

If you don't use a windshield, are you sure that you are measuring the noise you want and not the noise from wind hitting the microphone.

As an example, we made some quick and rough measurements using a 30cm desk fan and an optimus sound level meter. These are not very scientific measurements and were done as an example so please bear this in mind!

The optimus sound level meter was fixed to a tripod and the distance between the fan and the microphone was set at 0.5m.

After calibration, we made four measurements. We also made a background noise measurement to verify that the ambient noise levels without the fan running were consistent and more than 30dB below the noise of the fan.

The measurements were:

1. No windshield with the instrument in front of the fan
2. No windshield with the instrument at 90 degrees to the fan (we tried this to see what the level of noise from the actual fan was)
3. A standard 90mm windshield supplied with the optimus
4. A high performance 90mm outdoor measurement windshield with a hydro-scopic coating

The results of these measurements were:

- Measurement 1 – 74.7dB(A) - Leq over 20 seconds
- Measurement 2 – 52.4dB(A) – Leq over 20 seconds
- Measurement 3 – 53.8dB(A) – Leq over 20 seconds
- Measurement 4 – 53.8dB(A) – Leq over 20 seconds

This is a very simple and crude set of measurements but it is clear that the two windshields reduce the noise levels from the fan by just over 20dB(A).

The noise measured without a windshield is a combination of the noise of the mechanics of the fan, such as the motor and the aerodynamic noise of the blades as they spin round, and the noise generated by the moving air hitting the microphone.

What we are interested in is the noise from the fan and not the noise of the air. By using a windshield we reduce the effects of the turbulence over the microphone.

To protect the microphone from damage

The microphone capsule on your sound level meter is the most important part of the instrument.

It's the microphone that converts the changes in air pressure into an electrical signal. If this delicate part of your sound level meter is damaged in any way, your noise measurements could be incorrect.



Using a windshield can protect the microphone capsule from being knocked or banged when you are carrying the sound level meter around or when you are making measurements.

It's always good practice to use a windshield even when you are measuring noise indoors as this can often be the place where you are likely to damage the microphone. If you're using your sound level meter on a tripod, again always use a windshield.

Don't forget to remove the windshield before you calibrate your sound level meter. This may sound a bit obvious but we do get phone calls and emails asking how to calibrate the instrument with the windshield fitted.

To keep the microphone capsule clean

The moving parts of a microphone capsule are very delicate and very light in weight. Any contamination of the thin microphone diaphragm*, such as drops of water or dirt, can affect the way in which the microphone and the sound level meter measure noise.

Using a windshield for all noise measurements helps to keep these potential contaminants away from the delicate bits and keeps your microphone measuring accurately and as intended when it was designed.

Most microphones that are used on sound level meters use a protective grill above the diaphragm and this helps to prevent damage but using a windshield gives more protection.

*The diaphragm is the thin, light skin at the top of the microphone that moves with changes in air pressure.

Chapter 9

Why do I need to calibrate my noise measurement instruments?

If you are using your noise measurement instrument to meet any Standards, Regulations or Guidelines it is essential that your equipment is measuring accurately.

If you are working to the Noise at Work Regulations 2005, or any ISO or BS EN standard that requires the use of noise measurement equipment, the standards to which the equipment must comply will be clearly stated.

If you are going to continue to use your noise measurement instruments it is vital that they continue to meet these same standards.

Each time your instrument is used it should be calibrated using an Acoustic Calibrator before and after each measurement to check that it is working as correctly. This is field calibration.

However, as noise instruments are precision measurement instruments, they should be subject to routine verification to ensure that they continue to perform accurately. This is why you should have your instruments calibrated regularly by an appropriate laboratory.

Think of this as being like an MOT for your Sound Level Meter. Without this, are you sure that your instrument is performing to its original specifications?

Why is it not enough just to use an acoustic calibrator?

We also often get asked why an instrument needs to be calibrated every time it is used. A sound level meter or noise dosimeter is a precision instrument and so should be treated with care.

Any damage may not be immediately obvious and so using an Acoustic Calibrator before you make any measurements helps to check that the instrument will measure correctly.

However, using an Acoustic Calibrator only checks one level and one frequency and so regular servicing and calibration (Periodic Verification) is essential to ensure that all of the features and functions of your instrument are working correctly.

Can I use a sound level meter and acoustic calibrator from different manufacturers?

The current standard for sound level meters, IEC 61672, states:

‘At least one model of sound calibrator shall be stated in the instruction manual for checking and maintaining the correct indication on the display of the sound level meter’ (Section 5.2.1).’

The manufacturer of your sound level meter will have designed the instrument to be used with a specific acoustic calibrator, or calibrators, and these will usually be from the same company.

Richard Tyler's article "Coupling an acoustic calibrator to a sound level meter" in Acoustics Bulletin of March/April 2009 details the problems and his advice should be followed:

"The mix-and-match of manufacturer A's calibrator with manufacturer B's adaptor for calibrating manufacturer C's microphone/sound level meter is a recipe for error on a grand scale and should never be employed!"

It is unlikely that a sound level meter manufacturer will recommend the use of another's acoustic calibrator and so the information required to make any corrections or adjustments needed will probably not be available.

Therefore, do not use a different sound level calibrator from the stated one in the handbook by the manufacturer as there are many potential errors in trying to use a different one.

Chapter 10

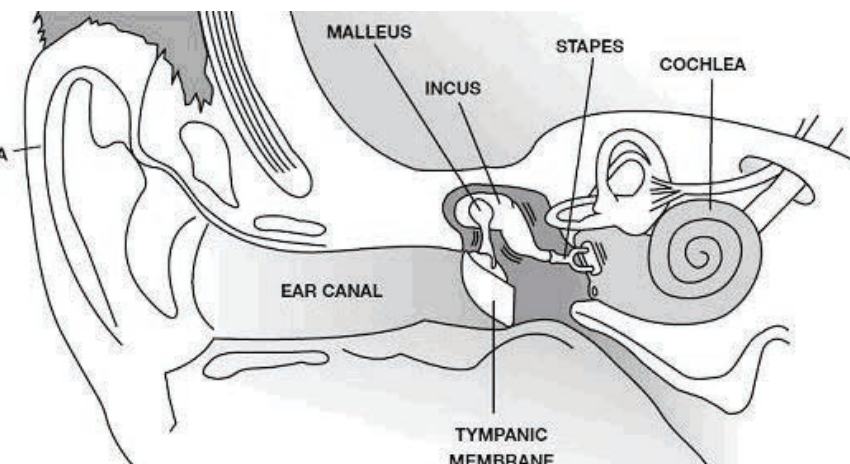
Noise induced hearing loss - an introduction

There are over an estimated 9 million hard of hearing individuals in the UK (source: 'Action On Hearing Loss (RNID), 2005 survey).

The overwhelming reasons for hearing loss are listed as being age-related and noise-related, very much in-line with other Western world countries.

The big difference is that while age-related hearing loss is a natural process that we can do little about, the same cannot be said for noise-induced hearing loss.

Why Does Noise-Induced Hearing Loss Happen?



A critical part of the inner ear is the cochlea which houses thousands of tiny 'hair cells,' responsible for sending signals via the nerve fibres for the brain to interpret as sound.

Prolonged exposure to high-volume noise can cause these hair cells to die, resulting in hearing loss.

Once the hair cells are damaged, any resultant hearing loss will be permanent as these hair cells are unable to regenerate.

When talking about noise-induced hearing loss, two main factors contribute to the level of hearing loss:

1. The level of noise measured in decibels
2. How long the exposure to the noise lasted

It is never too late to try to prevent hearing loss due to noise exposure. At the work place, areas that have sounds exceeding 85dB (decibels) will need to be the target of noise reduction controls.

Preventing Noise-Induced Hearing Loss

Reducing and preventing hearing loss caused by exposure to noise at the workplace was introduced as a government target in 1989 under the 'Work Regulations act of 1989'.

New legislation introduced in 2005 and enforced from 2006 placed yet more emphasis on preventing hearing loss in the UK's industry.

It clearly states that employers have a duty to prevent or reduce risks to employees from exposure to high levels of noise at work.

Reducing the possibility of hearing loss from noise requires a combination of steps rather than one simple solution.

These include pre-emptive steps in the form of noise level assessments using commercially available sound level meters and other instruments, introducing clear guidelines and safety procedures, giving employees access to regular hearing tests, as well as investigating

whether quieter machinery could be used.

A significant step following an assessment of the noise level is making wearing hearing protection mandatory. The most common forms being earplugs and earmuffs.

Earplugs

These normally carry an upper ceiling decibel reduction of 20dB to 28dB. They are available as disposable or custom made.

Earmuffs

These normally carry a higher upper ceiling decibel reduction than earplugs depending on their standard. Earmuffs could be used together with earplugs thereby extending the upper ceiling decibel reduction.

When wearing any type of hearing protection, some level of sound should be allowed to pass through. Complete sound isolation in some settings may lead to other health and safety hazards.

Noise-induced hearing loss is preventable. Exposure to harmful noise can cause irreversible damage to an individual's hearing. The solution is often a combination of steps starting with measuring the level of sound and aided by the use of hearing protection.

Article written Joan McKechnie BSc Hons Audiology & Speech Pathology. Joan works for Hearing Direct.

About Hearing Direct:

Hearing Direct offers a range of specialist products suitable for the deaf and hard of hearing. The team behind Hearing Direct have worked in the hearing aid manufacturing industry for years and their emphasis is placed on the improvement in quality of life these specialist products bring to the hard of hearing.

More information?

If you have a question about noise measurement or using your noise measurement instruments, you can email it to us through our website at www.cirrusresearch.co.uk or post it on our blog at cirrusresearch.co.uk/blog

You can call us directly on 0845 230 2434 from the UK or +44 1723 891655 from outside of the UK.

About Cirrus Research

After over 40 years in business, Cirrus Research has firmly established itself as a leading expert in the world of noise monitoring, providing equipment for a variety of applications including environmental, industrial and nuisance noise. Manufactured in the UK, Cirrus noise measurement instruments are used in a wide range of applications and across many different industries, incorporating the very latest in scientific and technological developments.

Founded in 1970 and with its main base in North Yorkshire, UK, Cirrus Research specialises in the design, manufacture and distribution of noise measurement instruments that are designed to help users meet the requirements of standards and legislation throughout the world. Sound level meters, outdoor noise measurement kits, doseBadge noise Dosemeters, safety officer noise kits, SoundSign warning signs and NoiseTools software, are just some of the equipment that Cirrus Research produces.

Along with its UK base, Cirrus Research has dedicated French, German and Spanish offices, together with carefully selected sales consultants and distributors in countries such as South East Asia, Australia, America and Europe.

Throughout the world, organisations and specialist noise consultants rely on Cirrus Research's noise measurement instruments for reliable results that will help them monitor sound in both indoor and outdoor environments.

Cirrus Research has implemented a Quality and Environmental Management program that has been certified as meeting the requirements of ISO 9001:2008 and ISO 14001:2004. It is also a member of the British Safety Industry Federation's Registered Safety Supplier Scheme. The scheme allows its members to identify themselves as having made a formal declaration that they are only selling safety products that are genuine and legal.

You can find out more about us at www.cirrusresearch.co.uk or you can call us and we will be happy to talk to you.

Additional Resources

Our website: www.cirrusresearch.co.uk

Our blog: www.cirrusresearch.co.uk/blog

Twitter: [@cirrusresearch](https://twitter.com/cirrusresearch)

LinkedIn: [/company/cirrus-research-plc](https://www.linkedin.com/company/cirrus-research-plc)

Environmental Noise Monitoring

www.cirrus-environmental.com

Optimus Sound Level Meters

www.cirrus-optimus.com

Trojan Noise Nuisance Recorder

www.cirrus-trojan.co.uk

doseBadge Noise Dosemeter

www.dosebadge.co.uk

Noise at Work

www.noiseatwork.co.uk





Construction Noise Monitoring

www.construction-noise.co.uk

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