

INDUSTRIAL APPLICATIONS

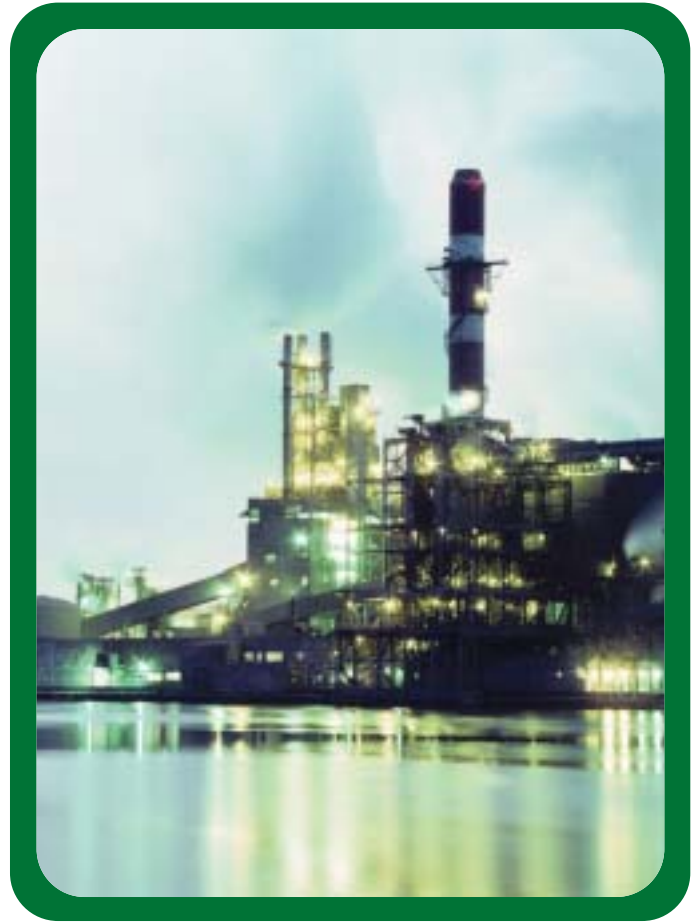
SOUND POWER MEASUREMENTS

The sound power of products (L_w) needs to be measured in order to adhere to international standards and legislations such as ISO 3744 and 2000/14/EG. Product noise has also become an important criterion for customers when choosing products and, therefore, must be optimised at the design stage.

The sound power of a product is the acoustic power emitted by the product and, unlike sound pressure, does not depend on the acoustics of the surroundings, the noise from other sources or one particular measurement position. This is why sound power is useful to quantify the noise of a product.

Traditionally, sound power has been calculated from sound pressure measurements made in anechoic or reverberation rooms in order to take into account the influence of the surroundings. The background noise level must be much lower than the level emitting from the product.

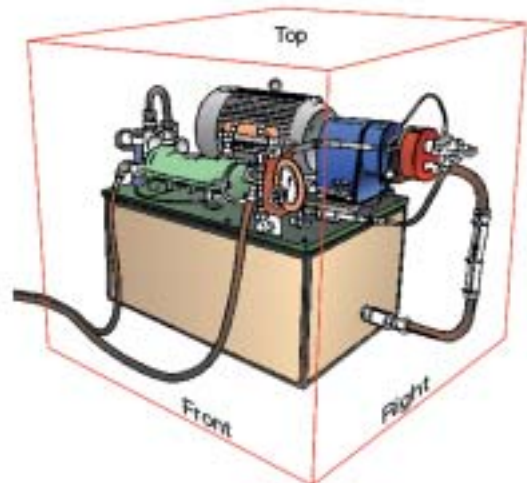
More recently, sound intensity measurements provide a more direct method of measuring sound power. Sound intensity is the acoustic power per unit area, and by multiplying the average sound intensity by the area over which the intensity is measured, sound power is calculated. Sound intensity is measured using a directional probe; therefore, sound power determined this way is, in principle, insensitive to background noise and sound reflected by the surroundings.



Pressure-based

The object is placed in a well-defined acoustic environment (anechoic, reverberant or semi-reverberant depending on the standard followed). A measurement surface (for example, a hemisphere) is defined, and the sound level measured at a number of surface positions to obtain a representative average. Background noise must also be

checked to control its influence. Next the influence of the environment (room correction) is determined using calibrated sound sources or reverberation time measurements. Finally the sound power is calculated taking into account the measurement surface, background noise and room correction.



Intensity-based

No special environment is required, making this method suitable for in-situ measurements of sound power for equipment that is difficult to move or install in a special measurement location. The measurement surface is subdivided to suit the size and shape of the object, thus providing a result for each sub-surface as well as the total sound power. Following the ISO 9614 standard, quality indicators are inherent in the measurement procedure to ensure accurate results.

The features of intensity-based sound power are:

- Insensitive to the acoustics of the environment
- Background noise level can be up to 10 dB higher than source level
- Partial sound power determination possible (for example, transmission and motor)
- Noise source identification (mapping)



RESEARCH & DEVELOPMENT

Product Noise Reduction

In the effort to reduce product noise and vibration, frequency analysis can be a helpful tool. Identifying the offending frequency bands is the key to locating the source and paths of noise and vibration. With this knowledge, the design can be changed to improve the product.

Noise Source Identification (NSI)

Visualisation of noise can give you vital clues to improving the product design. A colour map shows how different noise sources contribute to the total. Using software tools you can focus on trouble areas and make further analysis of sound power levels and frequency ranges.

Machine Vibrations

Machine vibrations are often measured because of standard and legislative requirements. Machine vibrations affect human comfort and can harm buildings. A suitable sound level meter equipped with a vibration transducer can give you vibration results on-site.

Troubleshooting

A case of excessive noise or vibration can relate to a new design as well as one already in production, but it usually takes intuition, knowledge and versatile tools to solve it. The symptom could be a rattle, a tone, or simply too much noise. Measurements like frequency analysis, logging or sound intensity can give a troubleshooter the evidence needed to solve the case.

Hand-arm Vibration (HAV) and Whole-body Vibration (WBV)

Manufacturers of equipment like hand-held power tools, fork lifts and earth-moving equipment must fulfil the requirements of international vibration standards for their products. Measurements have to be made during development and production to ensure conformance to standards. WBV measurements differ from HAV measurements in filter characteristics and the use of a seat pad accelerometer instead of a simple vibration transducer.

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QUALITY CONTROL IN PRODUCTION

At the end of an assembly line, unusual noise in a product can lead to rejection or rework. The noise is a symptom of faults in design, assembly or components, and an automatic noise check can help maintain the required quality level. It can also give rapid feedback to production planning and engineering if adjustment to design or production process is needed. The equipment for checking noise must be accurate, robust, and remotely controlled.

PRODUCT LABELLING

Legislative, standard or EU directive requirements often demand that products be labelled with sound and vibration levels. Products with the lowest levels will usually have a marketing advantage. Parameters required in labelling include L_{Aeq} , L_{Cpeak} and L_W , besides those of HAV and WBV.

Product Guide

Brüel & Kjær offers solutions to all the above-mentioned applications. Please use this table as a guide to relevant products.

Application	Key Features	Products and their Key Features
Sound Power, Pressure-based	<ol style="list-style-type: none"> 1) L_{Aeq} 2) $1/1$- and $1/3$-octave spectra 3) Multichannel 4) L_W and L_W mapping 	2240 Integrating Sound Level Meter ¹⁾ 2238 Mediator ^{1) 2)} 2239 Integrating Sound Level Meter ¹⁾ 2260 Observer ^{1) 2)} 3560 PULSE ^{1) 2) 3) 4)}
Sound Power, Intensity-based Noise Source Identification	Intensity Spectra L_W and L_W mapping	2260 Investigator 3560 PULSE
Research & Development Product Noise Reduction Machine Vibrations Troubleshooting	<ol style="list-style-type: none"> 1) L_{Aeq}, L_{max} 2) Logging 3) Event markers 4) $1/1$- and $1/3$-octave spectra 5) Vibration input and FFT 	2240 Integrating Sound Level Meter ¹⁾ 2238 Mediator ^{1) 2) 3) 4)} 2239 Integrating Sound Level Meter ¹⁾ 2250 Hand-held Analyzer ^{1) 2) 3) 4)} 2260 Observer ^{1) 2) 3) 4)} 2260 Investigator ^{1) 2) 3) 4) 5)}
Hand-arm Vibration ¹⁾ Whole-body Vibration ²⁾	Vibration level	2537 Hand-arm Vibration Meter ¹⁾ 2239B Integrating Sound Level Meter ¹⁾ 1700 3-channel Human Vibration Front-end ^{1) 2)}
Quality Control in Production	<ol style="list-style-type: none"> 1) L_{Aeq}, L_{max} 2) $1/1$- and $1/3$-octave spectra 3) Remote control 4) Event trigger 	2238 Mediator ^{1) 2) 3)} 2250 Hand-held Analyzer ^{1) 2) 3)} 2260 Observer ^{1) 2) 3)} 2260 Investigator ^{1) 2) 3) 4)}

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