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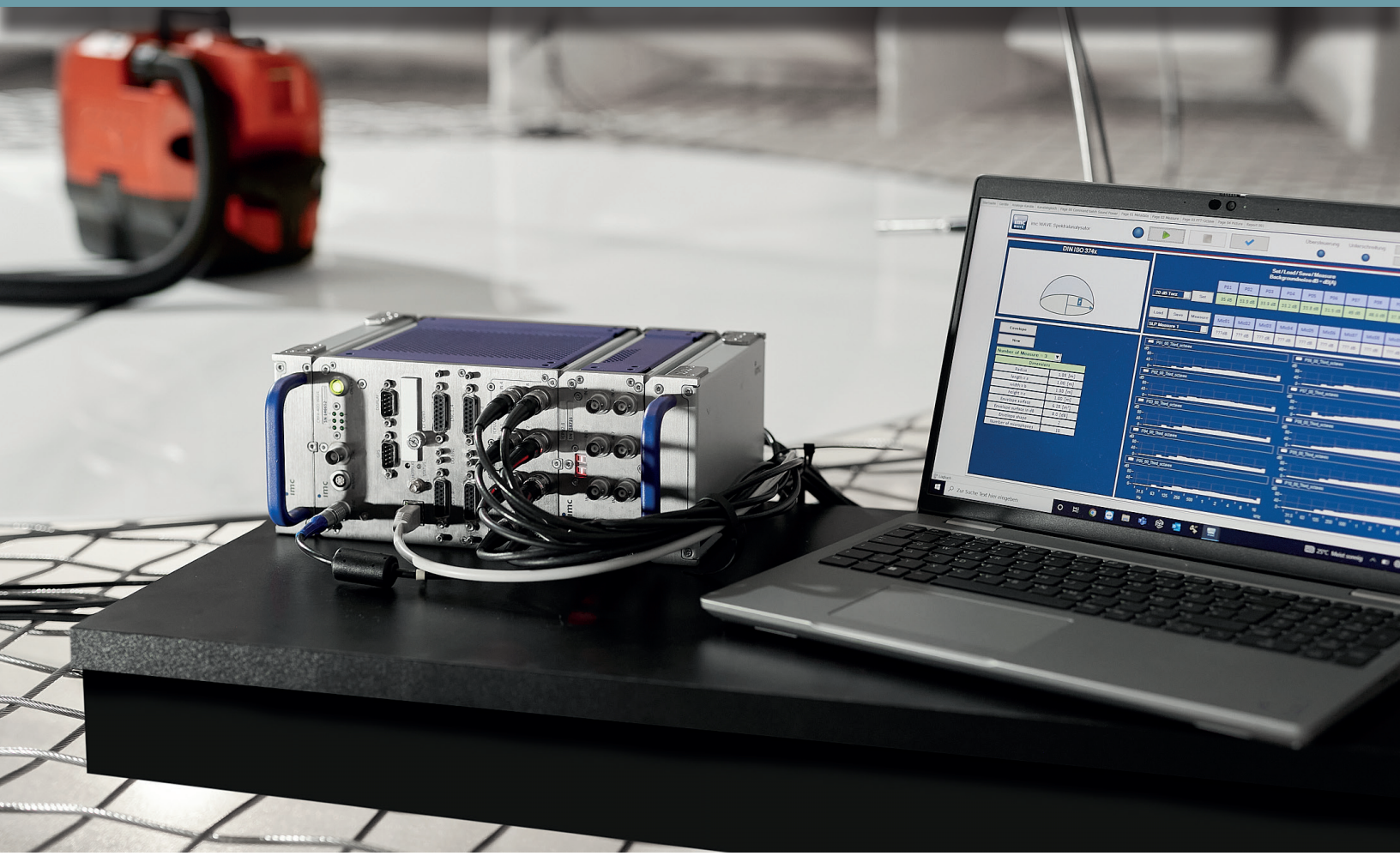

Noise Control

How to analyze the noise of hand-held electrical equipment according to standard?

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APPLICATION NOTE

Noise pollution as a health risk

The ever-increasing use of devices and machines in many areas of everyday life has made many activities easier for people. However, the downside of this automation is that many technical innovations are linked to noise pollution, which can be so high that it makes people ill. A permanently high noise level during long periods of operation of devices and machines is perceived as stressful. In the consumer sector, the engine noise of the grass mower or the rattling of the hedge trimmer that sounds from the neighbor's garden may come to mind. Frequently, however, the purchaser and operator of these devices associates the loudness with a powerful function or understands it as a quality feature - for example, a grass mower in the lower price segment has a sound pressure level of 79 dB(A) and a sound power level of 94.2 dB(A).

Obligatory measurements according to standard

This is where the legislator intervenes, reducing the sound emission limits at regular intervals. During product development, and often also in production as random end-of-line measurements, for example of hand-held electrical devices, the measurement of sound levels is therefore obligatory and specified by DIN EN ISO standards in order to ensure the safety and environmental compatibility of a product. The EN ISO 3741 - 3747 standards determine sound power and sound energy levels of noise sources from sound pressure measurements.

Measurement and evaluation of sound power and sound energy

In the example measurement presented here, a hand-held electric lopping shear is used. For the measurements, a hemisphere with microphones is used. It represents an imaginary enveloping surface with a radius of 1 meter. The hemisphere is placed around the measurement object and occupied by 10 microphones. A G.R.A.S. Hemisphere 67HA-05 with 10 microphones and a radius of 1 meter is particularly suitable for this purpose. The radius is defined by the standard in relation to the size of the object. Furthermore, according to the standard, the characteristic dimension of the test object must not be more than half of the measurement radius. Therefore, the use of hemispheres of different sizes is necessary for different devices, depending on the size of the device.

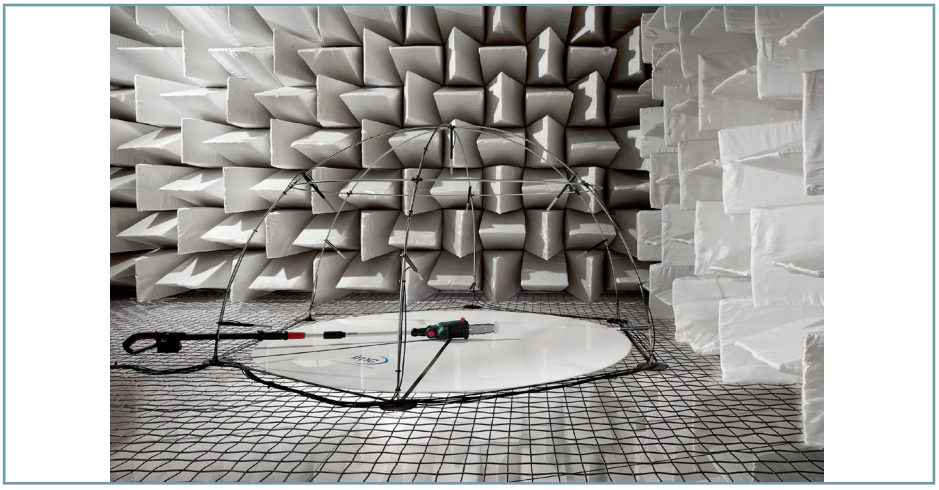

FIG 1.
Measurement setup for a sound power measurement on an electric lopping shear according to standard with hemisphere.

Data acquisition and data analysis

The imc CRONOSflex measuring system is used to record the measurement data. The modular design of the device allows spatially distributed measurements and an extension of the basic module by different measurement modules. The possibilities of the application locations of the individual modules as well as the number of measuring channels are thus scalable and almost unlimited. imc WAVE, a software platform for noise and vibration analysis (NVH analysis), is used for data analysis of the recorded measurement data in accordance with the standard.

FIG 2.
Modular DAQ system imc CRONOSflex

Data analysis according to standard with imc WAVE noise

The imc WAVE noise analyzer for noise and sound power analysis can be used to determine the acoustic properties of measurement objects. The software can process the signals from several microphones in parallel, online and synchronously. The properties of a channel can be entered manually or read in automatically via TEDS chip. In addition, sound power measurement according to ISO 374x is a separate function in imc WAVE noise. The software guides the user step by step through the standard-compliant analysis, from device configuration and calibration to measurement and a professional report. imc WAVE displays the arrangement of the microphones on the hemisphere in a diagram and recognizes whether the correct microphones with the correct calibration values have been used. After the measurement data has been recorded, the signals from the individual microphones are available as a recording, and the sound sources can also be displayed individually in graphical form.

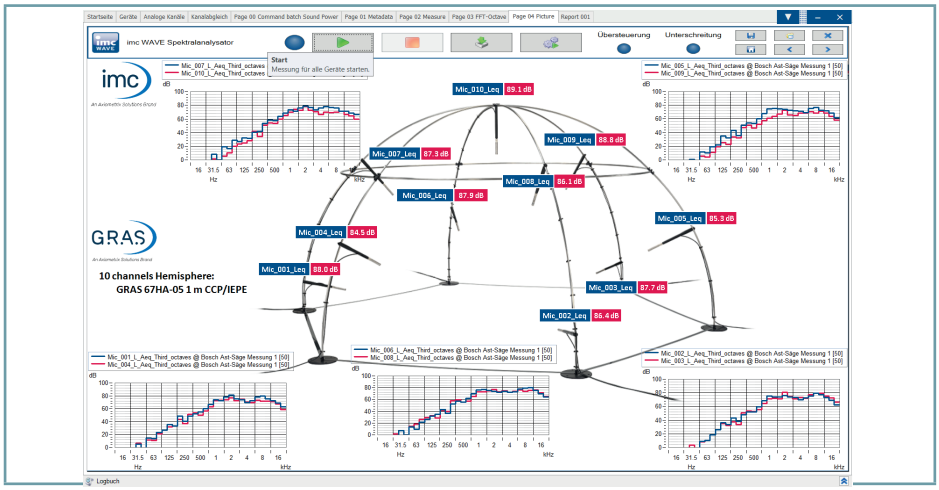

FIG 3.
The microphone configuration at the hemisphere represented within the test software imc WAVE noise

Calibration measurement of the microphone as an integrated function

Since a calibration measurement of the microphone must be performed before and after each measurement when measuring according to the standard, this is another central function in imc WAVE. The measured value of the integrated GRAS 42AG sound calibrator can be adjusted to the acoustic calibration value specified by the standard, or a control measurement can simply be performed. Both procedures are documented with the measuring channel. In addition to the sound analysis, the microphone signal can be calculated in the octave or third-octave spectrum and as an FFT analysis in real time and displayed as a 2D or 3D diagram (waterfall). In addition to the integrated functions, custom interfaces can be created in imc WAVE.

The functions of imc WAVE save time, all the more so if - as in the case of the loppers - the measurement has to be performed several times according to the standard because the instrument has a telescopic handle. In the diagram shown here, the sound immission at the operator's ears depends on how far away the sound source is from the operator. At a sound power level of 94.5 dB, the operator is exposed to a sound level of 76.9 dB at a distance of 2.10 m. The operator can hear the sound from the telescopic handle. If the operator extends the height adjustment from 2.10 m to 2.60 m, the sound pressure level decreases from 76.9 to 74.0 dB.

FIG 4.
Screenshot imc WAVE noise - overview of a measurement according to standard consisting of 3 averaged measurement runs

Simple handling, little training required

A complete test solution for measurement to standard, which can be used both in product development and for random monitoring of current production runs, includes a hemisphere to which several test microphones are attached and a measuring device as well as PC-based software for data analysis. One challenge in measurements with a hemisphere is the positioning of the microphones. This data acquisition solution promises easy handling with reasonable training effort. The only challenge in setting up the measurement should be the positioning of the microphones on the hemisphere. Once the measurement solution is set up, it enables time savings in test setup, measurement, and efficient evaluation of the measurement data.

imc Test & Measurement and G.R.A.S., a microphone manufacturer, provide a wide range of data acquisition hardware for this purpose, Various hemispheres from G.R.A.S. Sound & Vibration with 10 or 20 microphone types are used as sensors. These are connected to a measurement system from the imc CRONOSflex family. For calibration and start of the measurement as well as for evaluation of the measurement data and report generation we use the imc WAVE software. For measurements with up to eight channels, an imc CRONOSflex-400-WAVE with 400 kHz sum sampling rate including 8-channel measurement amplifier is a compact device. A measurement system that records more than eight channels is represented by the more powerful imc CRONOSflex -2000-GP, whose channels can be expanded in steps of 8 up to 24 channels by additional measurement modules. If even more channels are required, several imc CRONOSflex measuring systems can be synchronized and measured simultaneously.

The G.R.A.S. hemisphere is designed to be very user-friendly, as it is very easy to position the microphones according to the sound power standard. Since the microphones are easily accessible, the overall setup of the hemisphere and the microphones can be changed very easily for different objects. For example, more microphones can be used at the same radius to increase the accuracy of the measurement. Since the G.R.A.S. microphones have a TEDs functionality, connecting them to the measurement amplifier is easy because the correct calibration values for the microphones and their position can be synchronized automatically.