An introduction to sound power standards

By Mark Dowie, Application Specialist at Brüel & Kjaer

There are many reasons to perform sound power measurements and there are many standards to reflect this. This is a brief guide to the ISO standards available and what sort of measurement equipment is required.

The most commonly used sound power standards are:

- ISO 3744;
- ISO 3745; and
- ISO 3746.

These can be used for a very wide range of noise sources and are suitable for agricultural or construction machinery, pumps, generators and other industrial equipment. They would also be used to assess the sound power of domestic products like washing machines, vacuum cleaners, power tools and even dustbins. These three standards require a test area that is as close to a free-field as possible, the repeatability, due to background noise and reflections of the measurement environment will determine which of the three standards you are able to use.

An open area with minimal reflecting surfaces and a consistently low background noise; or a large room with a hard floor and some sound absorbing material on the walls would be sufficient for measurements to **ISO 3744:2010** (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free-field over a reflecting plane*). Good measurements can be performed in car parks after working hours and store rooms lined with office dividing panels.

If you have an anechoic chamber that is at least three times the width, length and height of your source, then you could use the precision method described in **ISO 3745:2012** (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for anechoic rooms and hemi-anechoic rooms*).

The simplest method is **ISO 3746:2010** (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*), this allows correction for almost any test environment but has the greatest measurement uncertainty. ISO 3746 is a useful method for acquiring real sound power data for use in environmental noise maps.

For each of these standards it is possible to use a Class 1 sound level meter, however, as the sound power calculation will require at least six measurement positions, it is much quicker to use a multichannel analyser with Type 1 microphones. If the source is not stable then it will be necessary to measure over a period that captures the range of levels produced by the source, for this, a multi-channel system will significantly reduce the test time.

All three methods describe various techniques for calculating the positions of the microphones, although the hemisphere shown in Figure 1 (below) is the most frequently used.

The calculations in these methods is based on the approximation to a free-field with little or no reflections, so that the measured level is only direct sound from the source.

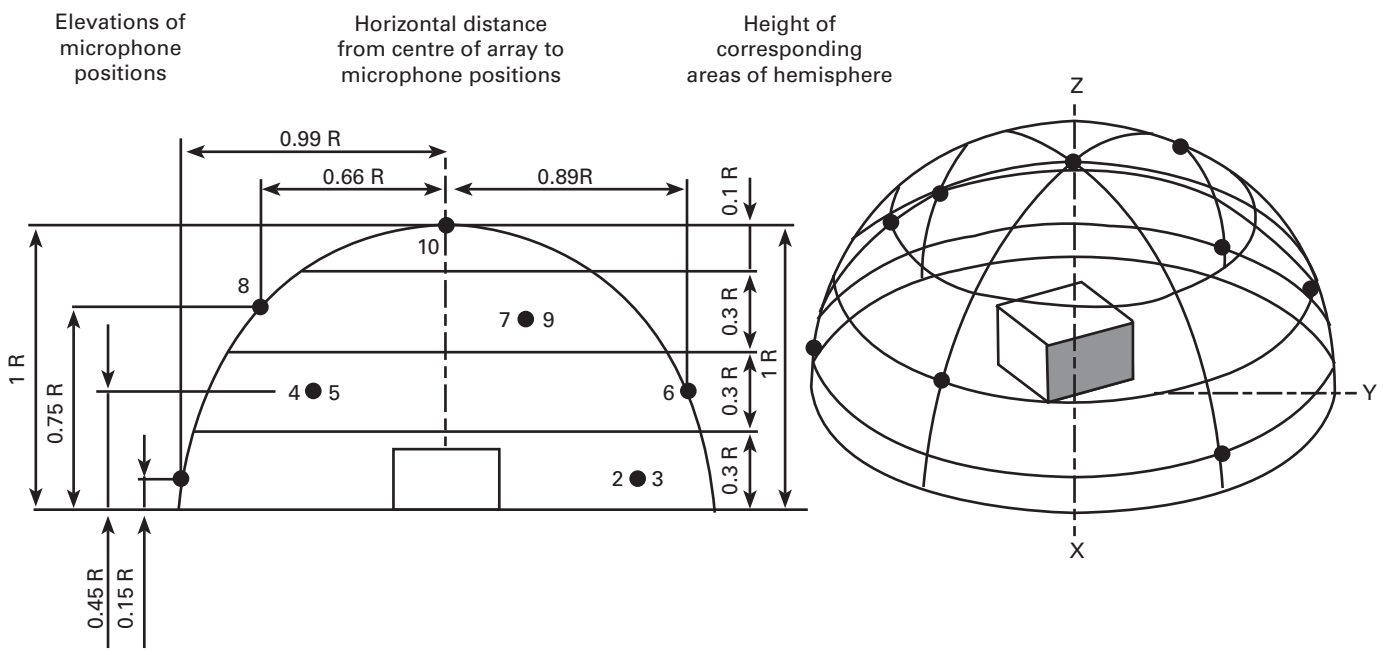

Figure 1 Microphone positions on equal areas on the surface of a hemisphere

Measurements in a reverberant chamber

The following standards provide methods for measurements in a reverberant chamber and would typically require random incident or diffuse field microphones. These methods either use multiple measurement locations or a rotating boom to take sample measurements of the stabilised sound field. For this reason, reverberation standards are best suited to sources that run at a consistent level.

ISO 3741:2010 (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms*).

ISO 3747:2010 (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering/survey methods for use in situ in a reverberant environment*).

ISO 3743-1:2010 (*Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for small movable sources in reverberant fields – Part 1: Comparison method for a hard-walled test room*).

ISO 3743-2:2018 (*Determination of sound power levels of noise sources using sound pressure – Engineering methods for small, movable sources in reverberant fields – Part 2: Methods for special reverberation test rooms*).

Intensity-based methods

If you do not have access to a free-field environment with low background noise or a reverberant room, then you maybe be able use one of the intensity-based methods.

ISO 9614-1:1993 (*Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points*).

ISO 9614-2:1996 (*Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning*).

ISO 9614-2:1996 (*Determination of sound power levels of noise sources using sound intensity – Part 3: Precision method for measurement by scanning*).

These work well for sources that can run in the steady state. Intensity systems tend to be less expensive than six or 10 channel systems used for ISO 3745 and 3744, and do not require a special acoustic environment. Intensity methods provide very quick, accurate results for small stable sources. By dividing the surface area of the source into squares (as per Figure 2) it becomes easy to perform reliable measurements even on large and complex sources such as diesel generators and industrial pumps. The scanning method allows for the intensity probe to be placed very close to the source – reducing the need for large test areas.

P16 ►

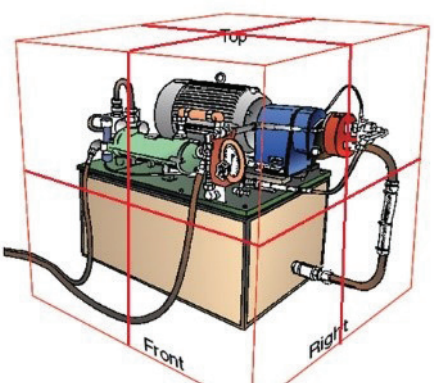

Figure 2 Virtual box over test object divided into squares

Figure 3 Rotating boom in reverberant chamber with acoustic diffusers

Heating, ventilation and air moving equipment testing

For manufacturers of heating, ventilation and air moving equipment, particularly if they need to test the several components as a system, then the following standards will apply:

ISO 5135:1997 (*Determination of sound power levels of noise from air-terminal devices, air-terminal units, dampers and valves by measurement in a reverberation room*). This has similarities to ISO 3741 and is usually performed using a microphone on a rotating boom (Figure 3). The analyser, which could be a sound level meter, measures for one full rotation of the boom. (This standard is about to be replaced by **ISO/NP 5135**).

ISO 13261-1:1998 (*Sound power rating of air-conditioning and air-source heat pump equipment – Part 1: Non-ducted outdoor equipment*).

ISO 13261-2:1998 (*Sound power rating of air-conditioning and air-source heat pump equipment – Part 2: Non-ducted indoor equipment*).

ISO 5136:2003 (*Determination of sound power radiated into a duct by fans and other air-moving devices – In-duct method*). This method requires a microphone, ideally pressure-field, to be placed in the flow of air inside the duct. To prevent wind induced noise on the microphone diaphragm it is necessary to use a nose cone or turbulence screen (Figure 4).

P18 ▶

Fans

There is also a set of standards specifically for fans:

ISO 13347-1:2004 (*Determination of fan sound power levels under standardised laboratory conditions – Part 1: General overview*).

ISO 13347-2:2004 (*Determination of fan sound power levels under standardised laboratory conditions -- Part 2: Reverberant room method*).

ISO 13347-3:2004 (*Determination of fan sound power levels under standardised laboratory conditions – Part 3: Enveloping surface methods*).

ISO 13347-4:2004 (*Determination of fan sound power levels under standardised laboratory conditions – Part 4: Sound intensity method*).

New detailed guide

Please be aware that the International Standards Organisation (ISO) is about to release **ISO/DIS 3740**, which will be a detailed guide to the ISO sound power standards. All the standards mentioned in this article are available from **www.bsigroup.com/en-GB/standards**

Figure 4 Microphone nose cone

The most commonly used sound power standards, ISO 3744, ISO 3745 and ISO 3746 can be used for a very wide range of noise sources and are suitable for agricultural or construction machinery, pumps, generators and other industrial equipment