Introduction to Mechanical Sound Data

Before background noise measurements are attempted, the mechanical engineer, architect or other design team members should have, at minimum, a basic understanding of acoustics terminology and knowledge of Octave-Bands, Weighting Networks, Sound Pressure, Sound Power, measurement standards and Logarithmic Addition. The introductions to these topics below are intended to give the reader a cursory understanding and are by no means comprehensive.

For more information on these topics and others that are more specific to your project design, we recommend researching on the web, reading acoustics textbooks, or having a discussion with an acoustics consultant.

Octave-Bands

In total there are 9 standard octave-band levels that can be reported representing 9 different octave band center frequencies as shown below. Typically, however, information is only given for bands 2 through 7 and occasionally octave band 1.

Octave Band #	0	1	2	3	4	5	6	7	8
Center Frequency	31.5	63	125	250	500	1,000	2,000	4,000	8,000

A-weighting

The human ear does not hear all frequencies with equal intensity even if the sound power or pressure levels are the same. Lower frequencies are heard fainter than higher frequencies. To account for this, weighting networks were developed based on how the typical human ear hears. These weighting systems are labeled A, B and C where A-weighting is the most commonly found in mechanical sound data.

A problem can occur when A-weighted sound power or pressure levels are given but it is assumed that they are linear (not weighted). A-weighting, by design, reduces the levels of the lower octave bands which are also the frequencies typically more difficult to mitigate in mechanical systems. Insufficient noise mitigation in the lower frequencies may occur if a system is designed using A-weighted levels when the designer is unaware that the data has been A-weighted with artificially reduced low frequency sound levels.

Before starting any background noise calculations we recommend "Un Weighting" any data that is A-weighted and starting with linear sound measurements.

Sound Pressure vs Sound Power

Simply speaking, Sound Pressure is a measurement of sound made in a specific environment (e.g. in a mechanical room, outside next to a building, in a classroom, etc.) The environmental factors play a part in the level of the sound measured. For example, it is fairly easy to imagine that noise from a generator enclosed in a small, hard, concrete mechanical room will be louder than the noise level of the same generator sitting in the middle of an open field.

Sound Power, on the other hand, is a measurement made in a laboratory that attempts to remove the sound source from any environmental factors that may play a part in the measured levels. Sound power information is beneficial because the sound information is only related to the equipment tested, not whether it was made in a small mechanical room or open field as the example above suggested.

For these reasons, it is important to know that Sound Pressure and Sound Power are different measurements and care should be used when determining which information is used in background noise calculations. Sound Power is convenient because it can be assumed to be the same no matter where the equipment is located. Sound Pressure is more easily measured and can be equally as useful if information on the measurement environment is known such as distance from the sound source and the room environment.

For most background noise calculations, Octave-Band Sound Power information that is *not* A-weighted is usually the most helpful to the designer

Measurement Standards and Other Specifics

There are a variety of Measurement Standards that attempt to ensure that sound levels measured on a piece of equipment in China would be the same as levels measured on the same equipment in Canada, and vice versa. The standards are a complete “rule book” for the ways the sound levels are to be measured, calculated and reported.

It is important to read and understand the specific standards used in reporting the equipment sound levels as many of them contain “level corrections”, specific inlet and outlet configurations and other situations that may or may not apply to the system you are analyzing.

Some well known standards are:

- ARI Standard 260
- ARI Standard 880
- ARI Standard 885
- ASHRAE Standard 130
- ANSI S1.4
- AMCA 303

Measurement Standards and Other Specifics

Sound Power and Sound Pressure are logarithmic values and need to be added as logarithms, not as standard linear values. Instructions on how to perform arithmetic with logarithms is beyond the scope of this short acoustics introduction but the chart below can be used for simple calculations.

Difference between levels	0	1	2	3	4	5	6	7	8	9	10
Add to the higher level	3	2.5	2.1	1.8	1.5	1.2	1	0.8	0.6	0.5	0.4

Manufacturers Supplied Sound Data – What to Look For & What to Watch Out For

Ideally, mechanical sound data received from the manufacturer will have the following information provided with it:

- Indication of Sound Power (Lw) or Sound Pressure (Lp) with a distance that the pressure measurement is made.
- Proper labeling of A-weighted levels. A-weighted levels should be "un weighted" before used in calculations.
- Indication of any standards that were used as well as assumptions made (duct end-loss reductions, estimated numbers, etc.)

Things to watch out for:

- Tables of numbers offering no clarifications of Sound Power, Pressure, A-weightings or standards used.
- Unclear labeling of data. When in doubt, call the manufacturer for clarifications.