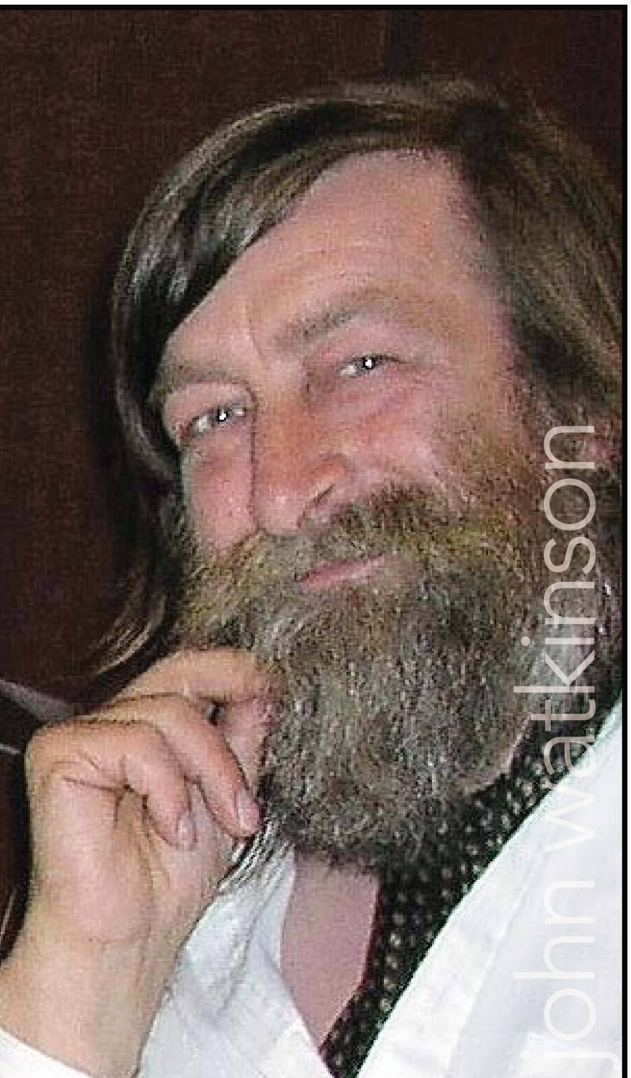
Equipment specifications

Audio equipment, like any other equipment, has specifications. But what do they mean? JOHN WATKINSON has always had concerns about audio specifications and shares some of them with you.



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I'M NO LONGER SURE what specifications are for. The scientific view is that they give a prospective purchaser something concrete about the performance of a product. The cynical view is that the purchaser has no idea what they mean and works on the more-must-be-better principle, buying the product with the biggest numbers on the spec that is also within the budget. The truth is somewhere in between. The more-must-be-better brigade must be quite large, judging by the way specifications are measured.

I think I took the first faltering steps towards cynicism when as a child I learned that the size of a TV tube is specified by measuring the diagonal, giving the biggest number possible for a given tube. A larger step towards cynicism was when I learned that the Institute of High Fidelity appeared to have re-defined the Watt to be smaller than real Watts so that audio amplifiers suddenly seemed more powerful. Another invention along these lines is the concept of music power, that is more powerful than real power, or even peak music power that is more powerful than music power. I read recently of a pair of active speakers suitable for use with a PC that claimed 20 Watts peak music power output. They come with a plug top power supply rated at 5 Watts!

A useful approach is to divide specification details into areas that affect sound quality and those that don't. For location work, portability, power consumption and ruggedness are important, but don't directly affect quality. For live work, the ergonomics of the controls are important, but again don't directly affect quality. Where the highest quality is the goal, areas such as size, weight, power consumption and user hostile controls are less important. One item that often isn't specified is how long it takes for the thing to work again after a power interruption. That bargain-priced workstation may not be such a bargain after you have bought the uninterruptible power supply without which it is practically unusable. That cheap radio mike may not be so cheap when it has munched its way through a stack of batteries faster than the better-engineered model.

If we consider areas that affect sound quality, the things that equipment can do to sound vary wildly, but all of these things boil down to some sort of filtering, the addition of unrelated signals, e.g. noise, or the addition of related signals, e.g. distortion. Sensible specifications can include frequency response, signal to noise ratio and total harmonic distortion.

Frequency response is generally considered to be highly important by audio engineers, probably because it is easy to measure. It's also fair to say that people can't get enough of it. There is now no shortage of equipment with a hopelessly over specified frequency response that appeals to the more-must-be-better brigade. The fact that there is no reliable evidence that vastly over specified frequency response is necessary doesn't enter into it. I don't have a problem with over specified frequency response provided the equipment actually does have the response claimed. Where I do have a problem is where claims are made for wide frequency response that the equipment cannot possibly deliver. SACD is a perfect example where we had a raft of propaganda extolling the massive audio bandwidth, whereas the designers of the noise shaping filters had set the practical bandwidth to be essentially the same as that of a regular Compact Disc.

Of course frequency response is meaningless unless the spread of levels to be expected over the specified range is also given. Thus if the frequency range is quoted without a number of dBs level range, it is a cosmetic specification.

It often seems that the only specification given is frequency response, whereas in audio what is needed is a balanced specification including frequency response, time accuracy and positioning or imaging accuracy. This is a great shame, because it is now well understood that high quality sound requires high time accuracy and imaging ability. While it is not particularly difficult to measure the time accuracy of audio equipment, a lot of manufacturers don't do it, or have done it and don't want us to know. In the case of loudspeakers, timing accuracy generally isn't quoted because it is appallingly bad, especially where stone-age techniques such as porting or transmission lines are used.

In the case of imaging accuracy, the audio industry doesn't even have a measurement technique or a unit. Every other industry that purveys images has a unit of imaging accuracy. We call ourselves audio professionals, but we have no way of measuring how well we are doing. The lack of a suitable unit has certainly impeded progress. Naturally, directivity has a large part to play in imaging. Microphone manufacturers are much more open about the directivity of their products than loudspeaker manufacturers. It's not uncommon to find that smoothing has been applied to speaker polar plots to make them look better. The official reason is that it reduces the amount of data needed for a polar plot, whereas physics says that it's the narrow dips and peaks in polar plots that cause image smear.

Signal to noise ratio is an important parameter, and in the digital domain this has a lot to do with word length. Convertor specifications make fun reading. The LSB is widely misused. An LSB is the bit at the bottom of a binary number that means one or zero. However, it is frequently misused to mean a quantising interval. When resolution or voltages within a quantising interval are being considered, we get fractions of an LSB. Of course there is no such thing as a fraction of a bit.

Distortion is a factor that is seldom described by specifications. It comes in two flavours. Linear distortion is where there is no change to the spectrum, but some frequencies lag behind others in time. Harmonic distortion is where extra frequency components are found in the spectrum due to a non-linear transfer function. Linear distortion is relatively inaudible on continuous sounds, but it destroys realism and imaging information in transients. It's typically not found in specifications.

Harmonic distortion is where the extra frequencies in the spectrum are related to the spectrum of the original sound. Actually in digital systems we can also get anharmonic distortion where distortion products alias. Distortion is usually quoted as THD (total harmonic distortion). While it serves a purpose, THD just lumps together all of the distortion products as a single quantity. Unfortunately, the ear is sensitive to the distribution of distortion products and two devices with the same THD can sound different because the distortion is differently distributed. Tube amplifiers working in Class-A can have quite large amounts of THD and the result is that the sound gets warmer (although it could be the heat from the tubes). The same amount of THD in a solid-state Class-B amplifier would sound excruciating.

The specification that really makes me laugh is the power handling of loudspeaker drive units. This can only be aimed at the more-must-be-better brigade. I would have thought that what was wanted was the actual sound power that could be radiated, but instead the power that is wasted as heat is specified. Thus the less efficient the drive unit, the higher the power rating can be. If cars were sold this way, the unit would be gallons per mile, also known as the Bush, and the car that consumed more gallons per mile would be the better one.

The incomplete specification was born and raised in the audio industry. To be really meaningful, a specification must include all of the parameters that affect the sound. By quoting only a few parameters, those are important by implication. There is then a temptation to design to the specification. For example, it is easy to extend the frequency response of an analogue tape recorder by under-biasing. If the frequency response is all that is quoted, it looks better. Pity that under-biasing raises distortion. Using resonance extends frequency response, but it does for the time accuracy.

We also have to consider the devices that are untestable by normal means. These include dynamic range compressors and things like bit-rate reducing coders such as MPEG. Test any of these with sine waves and they pass with flying colours. However, when a dynamic range compressor is changing gain, it must, by definition, introduce distortion. I don't see how a distortion specification is meaningful in such a device.

In the case of MPEG audio coders, the coder hasn't got a specification as such, because the performance depends on the bit rate and the difficulty of the source material. The audibility of the artefacts depends on the information capacity or resolution of the loudspeakers. Sometimes I wonder if I have become too cynical, but then along comes another wall of physics-defying propaganda. The current advertising for DAB digital radio makes a big play of the low-noise reception and slags off FM radio for buzzes and crackles. My FM radio doesn't buzz or crackle, nor does it suffer from MPEG compression artefacts. My first exposure to a real live DAB radio in a real live domestic environment was a massive disappointment. Instead of the rich pure sound promised on the box, it sounded to me like it had a sock in it. Maybe they were relying on the old meaning of pure, which was a substance used in leather tanning whose primary ingredient was dog droppings. ■