by Julian Hirsch

Optimistic Specifications: Loudspeakers

No consideration of optimism in hi-fi equipment performance specifications would be complete without discussing loudspeakers. In fact, speaker specs are virtually synonymous with optimism. It would be fair to describe most of them as pure fantasy, even if they were created with the best of intentions and technical skill. Sad to say, they rarely have the slightest kinship to the real world of listening to reproduced music.

In the case of an amplifier or tuner, it is possible to measure a single, unique output for each specific input level or frequency. Whether or not this sort of measurement is adequate to describe the listening performance of the component (it usually is not), it is reasonably repeatable and serves as a basis for comparing the performance of a product with its manufacturer's claims. For a phono cartridge, things are a little more complicated. We can measure a cartridge's output quite nicely, but we have no way of knowing what the input signal was. If we assume that a specific test record has a known frequency response (a generally unwarranted assumption), we can at least compare the output of a cartridge with what its manufacturer says it will deliver from that specific test record. Any other make of record (and often a different pressing of the same record) is unlikely to produce the same result. Still, for better or for worse, it is possible to make repeatable measurements and use them as an aid to a product evaluation.

With speakers, we simply have no easy way to get a handle on the input and output signal relationship. It is easy to define the input signal, whether it is a sine wave, pulse, noise, square wave, or anything else. But how does one define the "output" of a speaker? It can be a pressure measurement on any of an infinite number of axes and distances, or it can be a room measurement in the far field, with almost any combination of measurement time or bandwidth; it can be made in an anechoic environment or in a highly reverberant environment, or anywhere between those limits. The possibilities are endless. There is absolutely no standard or even a consensus on what the *real* output of a speaker might be in the sense that we use the term for other audio component specifications.

So, although we can easily determine what input is being supplied to a speaker, we have no way to define its output or even such portions of it that affect the sound we hear in the same room that was used for the measurement. Even if we could establish a clear input/output relationship for a speaker in a given room, it is certain that it would not be valid for any other room (such as *your* listening room). I rather doubt that we will ever be able to nail down the input/output speaker transfer function in such a way as to give more than the haziest of ideas of what its sound is like, if for no other reason than the near impossibility of defining subjective effects in objective terms with any degree of rigor.

In the light of the known problems in the speaker measurement area, let's look at some of the specs that are applied to speakers. Frequency response, for example: since a speaker's output can never be known, how do you define its frequency response? Easy. Just pick two nice limits such as 40 to 18,000 Hz (if you tend toward conservatism) or perhaps 20 to 20,000 Hz (if you don't). All this tells the consumer is that driving the speaker at a level short of its burn-out limits produces some measurable output over that frequency range outside the speaker cabinet. Often, tolerances are published as well, and ±3 dB or ±5 dB may be appended to the specification. Given the somewhat irregular nature of a speaker's output, these tolerances suggest a fairly close microphone placement, on the axis of the tweeter, and perhaps a moderate amount of smoothing of the measurement output to limit the plotted variations.

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Now, this measurement technique is not *wrong*. We do much the same thing here at Hirsch-Houck Labs, since there is good reason to believe that very narrow-band response irregularities have relatively little effect on a speaker's sound coloration compared with the effect of octave-to-octave variations. A certain amount of response smoothing is necessary to prevent the important information from being ob-

Tested This Month

JBL L100T Speaker System
Sony CDP-203 CD Player
Proton D1200 Power Amplifier
JVC DD-VR77 Cassette Deck
Cerwin-Vega 250SE Speaker System

scured by unnecessary detail, which in this context is equivalent to noise. The key point to remember is that almost all published loudspeaker frequency-response specifications are, if not invalid, at least unlikely to give a consumer any useful clues to what the speaker might sound like. Although our own speaker response curves help us to assess the overall quality of a speaker, they would probably not convey much information to readers of STEREO REVIEW, which is one reason why we do not publish them.

Most other speaker specifications have little to do with sound quality. Perhaps because of that, they do not seem to be subject to as much exaggertion or hyperbole as frequency-response measurements. Sensitivity, for example, is an important indicator of the amplifier power requirements of a speaker, and, despite different test conditions, we have found an excellent agreement between our measurements and those of most manufacturers.

When I discussed the matter of speaker power ratings in this column a few months ago, I pointed out that they are only a rough guide and should not be interpreted too strictly. Similarly, a speaker's impedance rating is little more than a guide to the user who might wish to drive more than one pair of speakers from the same amplifier, so that he can avoid loading the amplifier with an excessively low impedance. It has nothing to do with sound quality. In most cases, a speaker's impedance varies widely with frequency, although it is generally considered to be the first minimum value above the bass resonance frequency (an accepted rating method that is frequently ignored when the impedance specification is created).

Speaker distortion is another performance specification that is quite meaningless in most practical situations. The distortion of a speaker is rarely given, and you will understand why if you have seen the typical results of such measurements. There can be large variations in harmonic-distortion readings throughout the operating frequency range of any speaker. A major reason for such distortion variations is the speaker's irregular frequency response. If a speaker is driven with a 1,000-Hz sine wave and has a 10-dB peak at 3,000 Hz, any third-harmonic distortion will be tripled in the measurement. If the frequency is changed slightly (perhaps only by 1 percent or so) the distortion can easily change by a factor of several times. Without automatic-plotting distortion analyzers, such a measurement is impractical. Even if it is made, there is no evidence that moderate amounts of ordinary, low-order harmonic distortion in a loudspeaker are audible as sound coloration in reproduced music.

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Sometimes the distortion spec refers to intermodulation distortion (IM), a sum or difference frequency created when two signals of different frequency are applied to the speaker. That, too, is usually a meaningless rating, since in multiway speaker systems many IM frequencies are outside the passband of the driver in which they would be created, so they cannot be radiated by it. Fortunately, few companies publish speaker distortion ratings, and so far no one (to my knowledge) has been able to demonstrate its significance.

At Hirsch-Houck Labs, we do measure speaker distortion, but only in the woofer's operating range below 100 Hz. Most woofers are fairly smooth up to several hundred hertz, so these measurements can be made with reasonable accuracy. Our purpose is not so much to establish the inherent linearity—or lack of it—of the woofer, but to determine how low in frequency it can go before it loses its grip on the air, so to speak, and its cone excursions extend into nonlinear operating regions. This specification is almost never published by speaker manufacturers, but it is probably a more meaningful indicator of a speaker's true bass limits than any frequency-response measurement. □