BEHIND THE SCENES

BERT WHYTE

DO THAT VOODOO

One has but to look in the loudspeaker section of *Audio*'s Annual Equipment Directory issue (Oct.) to realize how many loudspeakers are on the market. If none of them seem to suit your tastes, in the opinion of some industry wags, "just wait 10 minutes and we will have another new loudspeaker for your evaluation." Apparently, there is a common belief that big bucks can be made in loudspeakers—just manufacture a model that tickles the public's fancy and you can start visiting Rolls-Royce showrooms.

Truth is, of course, most of the ubiquitous walnut boxes are of a numbing sameness in design and performance. Until quite recently, what changes and improvements were made in these speakers were a result of empirical art, rather than of scientific rationale.

In the last few years, black magic has given way to arcane disciplines in scientific analysis and design in the development of new loudspeakers. Such things come to mind as laser interferometry and laser holography, computer modeling, along with the use of Fast Fourier and Hilbert Transforms. And, of course, one of the most important of the new technologies is *Audio*'s own Richard Heyser's Time Delay Spectrometry and Time Energy Frequency studies. There is now a dedicated instrument for TDS and TEF, the Tecron System 10, manufactured by Crown International of Elkhart, Ind. Gerald Stanley, head of reseach for Crown, explained the System 10 in the November 1983 issue of *Audio*.

All the foregoing is preface to the story of the development of a remarkable new loudspeaker. When Crown introduced their new Tecron System 10 at the 72nd AES Convention in Anaheim, they made an offer that anyone who placed an order for the unit would be able to buy it at a special introductory price of around $10,000. (Current production price is $14,500, which is still a long way from the $35,000 to $40,000 assemblage of test equipment heretofore necessary to do TDS and TEF studies.) One of the people who took advantage of the offer was John Bau, director and designer of Spica, a small loudspeaker manufacturer in Sante Fe, N.M. After numerous delays, the Tecron System 10 arrived at Spica and therein hangs a tale.

The Spica TC-50 loudspeaker

John Bau wanted to develop a small, relatively inexpensive two-way loudspeaker that would exhibit good phase behavior, especially in the region from 350 Hz to 5 kHz. Working with their Hewlett-Packard 9845 computer and an extremely sophisticated engineering software program, plus the Tecron System 10, Spica's early investigations showed that the crossover network (really the heart of the loudspeaker project) would not meet their criteria using the usual Butterworth configurations.

This led to an exhaustive examination of Bessel filters as an alternative transfer function. Spica discovered many attractive things about them, but after much work, they did not find a high-pass function that summed perfectly with a Bessel filter. However, they did find one function that summed perfectly up to 5 kHz and used this as a target function when assembling some prototype crossovers. Using Time Delay Spectrometry, the delays between the 6½-inch cone-type dynamic woofer and the 1-inch dome tweeter (with crossover optimized to both amplitude and phase) were adjusted to match those of the computer model. They found on measurement that the phase response of the complete system was linear phase—±15° from 350 Hz to 4.2 kHz.

This is a very simplistic idea of the very complex research John Bau did at Spica, which resulted in the design and fabrication of the acoustic suspension, wedge-shaped Spica TC-50 loudspeaker.

The TC-50 measures 13 in. W × 15½ in. H × 11½ in. D. Frequency response is rated at ±3 dB from 55 Hz to 15 kHz. One watt at one meter gives an 83 dB SPL. Spica considers the phase response of the TC-50 in the midrange part of the audio spectrum, where the ear has maximum sensitivity, "near perfect." This speaker can handle 50 continuous watts of program power and 100 watts peak. Impedance of the TC-50 is 4 ohms. The wedge shape is, of course, to ensure that the woofer (really also a midrange unit at a crossover of 2.7 kHz) and the tweeter lie in the same acoustic plane for phase coherency. The Spica TC-50 sells for $420 per pair.

I can hear you commenting, "Okay, so what is the big deal? Those specs are not very impressive." On the face of it, you're right. But conventional specifications don't tell the story here. Just hook up the Spica TC-50 to a good-quality amplifier of somewhere around 25 to 100 watts and listen. If you react like most people, including yours truly, you will be positively amazed by the sound of these diminutive loudspeakers. The smooth naturalness of the overall response is notable, but it is the incredible imaging, front-to-back depth, accuracy of instrument localization, and stability that is so unexpected—and astonishing. Here are images *within* the sound field that are so realistic they are almost palpable. Try as you may, you simply cannot isolate sounds as specifically emanating from the right or left loudspeaker. Instead, we have a broad soundstage, a veritable panorama of sound. Bass response is clean and solid down to the −3 dB point at 55 Hz and then falls off rapidly. Depending on the amplifier used, the speakers can achieve surprisingly loud listening levels. But caution is necessary, since there is no

protection circuitry. However, if you should blow a speaker, John Bau says not to worry, as replacement speakers matched within 0.5 dB are readily available. In fact, John tells me all TC-50 speakers are kept to that 0.5-dB tolerance. Transient response of the TC-50 is remarkably good, and, as long as the speaker is not overdriven, distortion is quite low. The major impression one immediately perceives with these loudspeakers is their effortless naturalness and their sheer musicality. They are among the least fatiguing speakers extant.

What is the secret behind all this exemplary performance? Why, friends, it is largely in the design of the crossover, which, as noted, was achieved with the comprehensive use of the Tecron System 10 Time Delay Spectrometry and TEF facilities, as well as the HP 9845 computer. One certainly must not forget to give credit to John Bau, who broke with traditional concepts of filter design and whose new crossover has provided such a significant advance in sonic quality.

John tells me that current developmental work will soon bring forth a new three-way Spica and, not too far down the line, a servo subwoofer system.

Some Spica enthusiasts have bought two pairs of the TC-50 and placed them on their sides, one pair stacked on top of the other, with the tweeters facing in, in an effort to obtain more level and more bass. The floor position will help in and of itself, but there will be acoustic coupling of the two woofers, and indeed will be an increase in bass. John Bau states that this positioning will upset the acoustic geometry of the TC-50 and degrade its imaging qualities. Nonetheless, many people say it doesn't affect them much and they're happy with this setup.

As for myself, I have used the TC-50s with amplifiers ranging from an 80 watt/channel Audionics, to a 200 watt/channel Levinson ML-3, and a 200 watt/channel conrad johnson tube amplifier. (The latter two used with extreme care!) I've combined the TC-50s with a pair of Janis W-1 subwoofers, which have 100-watt interface amplifiers/crossover at 100 Hz. The result was sensational—all the solid, clean bass you could desire, down below 30 Hz, with wonderful musicality and superb imaging. Using the conrad johnson Premier One amplifier to drive the TC-50s from 100 Hz up, there was plenty of level, and I dared a few CDs without disaster. With the subwoofers and interface units nearly six times the cost of the TC-50s, this might seem silly, but John Bau tells me quite a few people are doing just that with a variety of subwoofers. Of course, it is a darn good reason why John is designing his own subwoofer.

How nice to have a success story like the Spica TC-50, especially since it was science, not hocus-pocus, that won the day.

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