Subject: Re: An amazing listening session with the H290C
Posted by Wayne Parham on Thu, 18 Apr 2013 14:26:35 GMT
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You definitely want the Rs resistor installed and the C1 capacitor removed. This provides the best response. Of course, you can always leave C1 in place, but doing that gives a slightly tilted-up response, totalling about 3dB more at the very top end.

The beauty of DIY is you can tweak to suit your taste. I think that is what Bill is saying here. He likes his speakers to have a smidge more up top. It's not a huge difference, subtle, but definitely audible. You can always try it both with and without C1 and see how you like it each way. But if flat amplitude response is your goal, remove C1 because it definitely measures flatter.

Resistor Rs is actually there just to shave off Zmax. I've used snubber resistors like that in many designs. Search "Zmax" here and you'll see lots of discussions about this over the years. Its purpose is mostly to make the design more robust, more tolerant of operating shifts and unit-to-unit variations in compression drivers.

After the H290C upgrade, internal reflections are reduced to best-of-class levels and response is very smooth. Other waveguides don't have the right shape (flare profile and ratio of length to mouth area) to give such smooth response. Ours is ruler flat. See measurements in the thread below, at the top of the second page.
H290C Horn/WaveguideA little more tech talk, history of the development of the H290C:

Waveguides have a lot in common with conical horns, which have been a specialty of mine for over 30 years. I've made conical horns and waveguides for every frequency range - tweeters, midrange and even some midbass units. One thing I've learned is that throat area and length are as important as mouth area in a conical horn or waveguide. That fact seems to have been lost on some, who see these devices purely for their directional control.

It is interesting for me, because for many years, most other hifi horn implementers were more concerned with acoustic impedance than directivity. Seemed like directivity was a side-effect to them. So in that environment, I was probably more concerned with directivity than most others. However, I have seen a shift in recent years towards directivity as the primary focus, much like it is in the prosound world. Here, I find myself talking more about the acoustic load, because I think many newer horn/waveguide hobbyists have overlooked its importance.

Directivity and acoustic impedance have a symbiotic relationship. Things that affect one almost always manifest themselves in the other. Where there are impedance peaks, you can usually find ripples in directivity. And where you see directivity shifts, you usually also see response and impedance ripple. They all tend to reflect upon one another.

Conical horns and waveguides create a radiation pattern that is defined by the wall angle, for the most part. However, at the low end of the range, directivity narrows, becoming smaller than the wall angle. And below that, it opens wide up. This directivity shift can be seen in the response and impedance curves. It also shows up on a baffle, by the way, which is essentially a 180° waveguide. That's basically what causes the so-called "baffle step". But I digress.

The throat area, mouth area and length all play an important role too. A horn has to be long enough to provide adequate acoustic load at low frequencies and it has to have enough mouth area to release the wavefront without excessive reflection. This mouth termination is really important, as is the length, especially in a conical horn or waveguide, since loading is compromised at low frequencies.

A truncated horn creates a reflection at the mouth. When severe, it can adversely affect the entire passband. In contrast, diffraction at the mouth edge only affects the lowest frequencies. So reflections caused by having an abrupt mouth termination from a truncated horn are far more objectionable than edge diffraction at the mouth.

While it is attractive to radius the mouth edge, it definitely shouldn't be given a higher priority than acoustic loading. A radiused mouth edge helps smooth the directivity transition at the low end of the range, where the horn/waveguide waistbands and then goes omnidirectional. But the radius does nothing from midband up.

This is why the H290C flare profile is purely oblate spheroidal, having length/area ratios that provide smooth response and only the edge at the mouth radiused. It has no secondary flare, no opening up at the mouth. It provides nearly constant directivity without sacrificing sound quality.

If you set wall angle and throat area as fixed dimensions, then mouth area is a function of length. So in a way, you can think of a horn/waveguide having cutoff based on its throat size and wall angle. These become constants, since mouth area is set by length. The length sets the mouth area (or vice versa), which largely determines acoustic loading characteristics, and ultimately sets the amount of response ripple.

This also has an indirect effect on compression ratio, since the throat area compared with the diaphragm radiating area set compression ratio. The best designs strike a balance between compression ratio and throat area, to obtain good acoustic loading and maximize efficiency/bandwidth ratio while simultaneously minimizing ripple through proper choice of throat size. Because, again, throat area and wall angle make mouth area versus length become contstant.

Of course, mouth area can be increased using a secondary flare. As mentioned above, this is sometimes done to counter waistbanding, almost always in prosound horns. But this does not increase length, which is vitally important in a conical horn or waveguide, to provide adequate acoustic loading. So there are competing priorities in that regard.

Mouth shape sets mouth area too, with a round or elliptical mouth using less baffle space as mouth area. This tends to favor rectangular horns, since they make use of all available space to improve the mouth termination and reduce internal reflections. But a round or elliptical mouth can be made to work too, it just has to be larger and longer to maintain parity.

My point is there are competing priorities in horn/waveguide design, and I personally would never choose a design that optimized directivity at the expense of acoustic response. I wouldn't discount directivity either, of course. That's the main reason I prefer radial horns and waveguides, for their superior directional characteristics. But I think the point is we're not looking for array-ability in a high-fidelity waveguide, we're looking for quality when implemented in a DI-matched two-way speaker, crossed to a midwoofer, or constant directivity cornerhorn, crossed to a midhorn. We're looking for superior sound when used in a high-fidelity speaker. Based on years of study in conical horns and waveguides, I believe the H290C is the absolute best choice for designs of this type, the best size and shape for a high-fidelity tweeter waveguide.