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Subject: OS waveguides

Posted by [Rapid](#) on Thu, 02 Jun 2005 22:09:42 GMT

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Hello!!I've read a few pages in Earl Geddes acoustic waveguide theory paper from 1989. It says that the oblate spheroidal waveguide requires a wavefront that is planar axisymmetric and it's found at the end of a properly designed phase plug or emitted by a vibrating circular piston. I wonder which devices would give a planar axisymmetric wavefront except for compression drivers? Ribbons (but I guess it can't be rectangular)? Other speakers? What does a dome tweeter give?I haven't taken any courses in acoustics (but is M.sc in EE), so I don't understand most of the things in the paper Anyway, it's interesting to read and try to understand./Mattias

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Subject: Re: OS waveguides

Posted by [Wayne Parham](#) on Fri, 03 Jun 2005 03:36:22 GMT

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I'm sure Earl will chime in, but I wanted to interject one thing that he and I talked about in this regard. Most agree that the phase plug should be matched to the horn. Instead, there are a handful of common shapes installed in most compression drivers, such as those using radial or annular ring slits. It would be better to have a variety of interchangeable phase plugs for different applications. This doesn't address your post; Earl would be best to discuss his papers. But it is germane in the context of a "properly designed phase plug."

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Subject: Re: OS waveguides

Posted by [Rapid](#) on Fri, 03 Jun 2005 07:07:46 GMT

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Thanks! I'm not sure about 1" drivers but in the JBL 2445 you could remove the phaseplug, so maybe it's possible to build one that's better and change it?

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Subject: Re: OS waveguides

Posted by [Earl Geddes](#) on Fri, 03 Jun 2005 12:49:40 GMT

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HiGlad that you could get something out of my paper. The book, which is updated and written ten years after the paper, does a far better job at explaining things.You are pretty much correct that a compression driver can actually create a flat planar wavefront. The first source that we tried

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however was a flat honeycomb piston from Panasonic. Worked just as expected. A conical diaphragm does not give a flat wavefront at the throat and as such the waveguide does not work well without a phase plug. A dome is an axisymmetric source, but not planar, as such it will not work as well as the flat piston. When the source is not planar then the performance is very hard to predict since the non-planar aspects will excite the detrimental higher order modes. I should also point out that current phase plug designs do not really give flat planar wavefronts either. That's because of an error in the design assumptions made by Bob Smith from whose work the current phase plug designs originate. I have a patent pending on a correction to the design which would achieve a flat wavefront. I also have a patent pending on the use of interchangeable phase plugs in a compression driver. I've been doing a lot of work in this area in the last couple of years. I think that my speakers can attest to the benefits of that work. Earl

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Subject: Re: OS waveguides  
Posted by [Rapid](#) on Sat, 04 Jun 2005 18:48:16 GMT  
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Hello! A few more questions: Would ribbons work in an OS waveguide? Would that require the diaphragm to be circular? Is there any disadvantage of using ribbons (if it works)? Thanks for taking your time and answering! Mattias

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Subject: Re: OS waveguides  
Posted by [Earl Geddes](#) on Sun, 05 Jun 2005 13:00:38 GMT  
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An OS waveguide is axisymmetric, so the source needs to be axisymmetric. There are waveguides which would work with a ribbon, like Prolate spheroidal or Elliptic cylinder. The disadvantage of a ribbon is that they are low efficiency and expensive while offering no real advantage. That said some people in Europe have used waveguides on ribbons, but then they changed to compression drivers for the reasons that I mentioned.

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Subject: Compression drivers in general  
Posted by [Rapid](#) on Sun, 05 Jun 2005 20:48:09 GMT  
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I see, devices which give axisymmetric and plane waves doesn't seem easy to find. A compression driver has like 105dB sensitivity while the 15" bass lies in the 96-99dB region. I'm thinking the extra sensitivity of the compression driver isn't needed since it'll have to be attenuated in the crossover anyway. Is it possible to improve the compression driver (more linear?) but

sacrificing some sensitivity? But I guess building/improving compressiondrivers is out of the scope for a DIY:er Cheers,Mattias

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Mon, 06 Jun 2005 02:35:59 GMT  
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"devices which give axisymmetric and plane waves doesn't seem easy to find"Quit the contrary they are the most common sources for waveguides - compression drivers."A compressiondriver has like 105dB sensitivity while the 15" bass lies in the 96-99dB region. I'm thinking the extra sensitivity of the compressiondriver isn't needed since it'll have to be attenuated in the crossover anyway"All of which is a good thing. Sensitivity is relatively unimportant - unless its really low - its Max SPL that matters. And a compression driver has lots of that. Sure a 1" tweeter would work on a waveguide, they work fine, but they suffer from limited LF capability and really loose it at higher SPL's. I also use the high sensitivity to advantage in my passive crossovers with the resistor pad for lower the sensitivity. This makes the driver look almost like a purely resistive load, which is ideal for passive crossovers."Is it possible to improve the compressiondriver (more linear?) but sacrificing some sensitivity?"My studies have shown that compression drivers have no perceivable nonlinear distortions at any level - even 124 dB. So I would say that a compression driver is just about the ideal HF source. And, of course, this is what I use. It is not a coincidence.But compression drivers on horns have a deserved reputation for poor sound quality. I fixed this problem and now consider them to be the best available source for HF response - even for audiophile loudspeakers.

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Subject: Re: Compressiondrivers in general  
Posted by [Rapid](#) on Mon, 06 Jun 2005 07:54:28 GMT  
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Hello Earl!Yes, your speakers are very interesting. By the way, do you have any retailer in Europe? When I was saying more linear I meant smoother frequencyresponse, or that's mostly determined by the waveguide?Regards,Mattias

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Mon, 06 Jun 2005 11:58:55 GMT  
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Basically I don't have dealers for my speakers anywhere. I build them here and sell them from the web. This is what allows me to keep the prices low.In discussions of this sort it is essential that

we delineate linear distortions from non-linear distortions. Frequency response aberrations are linear. The horn or waveguide dominates the frequency response of the system, although there are a couple of driver effects. One is the resonance of air around the voice coil - this needs to be controlled - and at higher frequencies there are diaphragm resonances. But basically compression drivers are far flatter devices than piston sources. This is because of the high damping both acoustically and electro-mechanically.

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Subject: Re: Compressiondrivers in general  
Posted by [Martin Goedeke](#) on Tue, 07 Jun 2005 08:10:30 GMT  
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"My studies have shown that compression drivers have no perceivable nonlinear distortions at any level - even 124 dB."Does this include behaviour under power at relatively low frequencies? You cross a 1" exit driver at around 900Hz-1kHz which is considered very low in pro-sound circles. How does the loading of an OS compare to say an exponential (or others) for high-SPL use (assuming same mouth area)?

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Tue, 07 Jun 2005 12:25:34 GMT  
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Our study of distortion had a crossover at 1000 Hz. Remember that in a Home Theater one would never even come close to the SPL's that these devices are capable of. No, I don't think that nonlinear distortion is an issue at all in a non-pro application. In sound reinforcement the situation is clearly different. One is always trying to operate these devices at their upper limit. So I would not take a 1" Comp-Driver down to 900 Hz. In most of my designs for pro, I use a 2" driver down to 1.6 kHz or so and then there are sometimes three of them per cabinet. The pro world and the home world are quite different. Loading of a waveguide, or horn, is a totally over-blown concept. For all practical purposes any shape with the same throat and mouth areas will have about the same loading. Some may have a little more somewhere and another a little more somewhere else, but they will all be within about 1 dB of each other. I pay no attention what-so-ever to loading. I only care about wavefront formation, internal reflections and diffraction and the resulting polar response. I can easily EQ any "loading" differences, but I cannot correct any of these other properties after the fact - they must be corrected in the design.

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Subject: Re: Compressiondrivers in general  
Posted by [Martin Goedeke](#) on Tue, 07 Jun 2005 12:50:57 GMT  
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Interesting. The lowest crossover would be determined by power handling and diaphragm Vd then I presume. So one gets 1.4"-2" drivers that have a nearly planar wavefront or correctly curved wavefront at the throat to enter into a (presumably, or at least in one direction) narrow dispersion horn. Any suggestions as to suitable drivers? (The BMS 4550 is known to be a very, very efficient driver that can be crossed very low for instance and outperforms for eg the B&C DE700 according to some German designers but you have commented in response to Tom Danley somewhere that they don't strike you as suitable) 3 large format compression drivers per cabinet would be some very narrow dispersion waveguide like in a line-array presumably?

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Subject: Re: OS waveguides

Posted by [Earl Geddes](#) on Tue, 07 Jun 2005 13:04:30 GMT

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Wayne Yes, you are correct. I have done a lot of work in this area. Each desired polar response dictates a mouth wavefront shape. This seems obvious, right. The OS waveguide will only ever yield an axi-symmetric wavefront and hence axi-symmetric polar pattern. To me this is nearly ideal since that is the pattern that all piston drivers have (except some obscure ones - ovals, square). So matching waveguide directivity to a piston dictates an OS waveguide. But with multiple piston drivers at low frequencies a non-axisymmetric pattern could be achieved which would require a different waveguide. There are two possibilities here; prolate spheroidal; and Ellipsoidal. The first is rectangular and the other is elliptical in cross section. In fact the OS waveguide is a special case of the Ellipsoidal. These three waveguides all require different shapes at the throat - rectangular, elliptical and circular. It is possible to design an adapter, but this is less than ideal. Ideally the phase plug should create the proper shape at the compression drivers exit aperture. Hence a specific phase plug for a specific application. I applied for a patent on interchangeable phase plugs several years ago. After much discussion with the USPTO, it looks like it will be issued within the next year.

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Subject: Re: Compression drivers in general

Posted by [Earl Geddes](#) on Tue, 07 Jun 2005 13:18:05 GMT

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"Interesting. The lowest crossover would be determined by power handling and diaphragm Vd then I presume" Correct - that's the determining set of factors, but it's really the Vd required at the maximum expected SPL. If this can be accommodated then the driver is fine. "Any suggestions as to suitable drivers? (The BMS 4550 is known to be a very, very efficient driver that can be crossed very low for instance and outperforms for eg the B&C DE700 according to some German designers)" Strange how German designers find German products superior to Italian ones! For the most part I find the contrary - I like and use B&C compression drivers and I have tested some BMS units that were pretty bad, some are better. But honestly, most drivers are about the same.

Take them apart! Do any of them look any different? You can practically interchange the parts. I use B&C because they work as good as much more expensive drivers (like TAD, JBL, etc.) at a fraction of the cost. Why pay for a brand name when there is no perceptible audible improvement? I am not prone to buy a brand name as I know enough to be able to sort out good from bad, and I can, and have, tested a wide variety of these devices. Simply stated - brand does not buy you quality. Some models of each brand are good and some are not so good. In general, I have found B&C to be the very consistent at a low price - a very good value. I use the B&C DE25, now the DE250 and I have tested more than a half dozen competitors. Some are comparable in performance, but not in price, and none are comparable in price/performance, which is why I still use the DE25.

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Subject: Re: Compressiondrivers in general  
Posted by [Martin Goedeke](#) on Tue, 07 Jun 2005 14:15:31 GMT  
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The designer (Audio Zenit) uses an Italian OEM (not the usual suspects though) for most of his cone drivers and the particular comparison was that on similar horns the two compression drivers mentioned were put up against one another on a measurement basis (crossed @ 1kHz on top of a loud 2x8" horn) and the BMS was apparently an obvious choice (a 1" with apparently more Vd than many 2" exit drivers) BMS does use a different topology in all fairness (I take it your disappointment was with the 2" co-ax) and their drivers tend to be crossable very low. 18Sound goes on about a phase plug they use (in the 1480 and 2080 esp) which seem to be very well behaved in combination with their waveguides. Is their work related to yours?

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Tue, 07 Jun 2005 15:38:03 GMT  
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Since drivers differ in regard to the way they perform on a horn, I would never consider such a comparison valid since on another horn the results might be completely different. I prefer to see data on a plane wave tube. My disappointment was with the coax which was obominable at the crossover. There single diaphragm drivers are about the same as everyone else's. I am not aware of what 18 sound has done, I worked with B&C. Perhaps my work leaked out, but that's OK since the concepts are patented so it won't matter how they got the idea if it's the same as mine. I have found that most claims in this biz are meaningless. Big claims, little difference.

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Tue, 07 Jun 2005 15:49:44 GMT

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I could not find anything about a phase plug on the 18Sound web site. How did you come by this information?

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Subject: Re: Compressiondrivers in general  
Posted by [Martin Goedeke](#) on Tue, 07 Jun 2005 18:32:56 GMT  
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I remember reading about the "patent pending" phase plug in other datasheets, so perhaps they changed that.<http://www.eighteensound.com/pdf/ND1060.pdf>.

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Thu, 09 Jun 2005 19:37:01 GMT  
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Yea, I see that on their data sheet. That could mean anything, but I will look it up on USPTO.gov.Thanks

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Subject: Re: Compressiondrivers in general  
Posted by [Earl Geddes](#) on Thu, 09 Jun 2005 19:50:30 GMT  
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Yea, I see that on their data sheet. I looked on the USPTO site under everything that I could think of and found nothing by Eighteen sound let alone a phase plug.Thanks

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Subject: Re: Compressiondrivers in general  
Posted by [wunhuanglo](#) on Tue, 21 Jun 2005 16:25:20 GMT  
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Maybe it's because they're an Italian company - maybe it's an Italian patent or is there European Union patent organization?

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Subject: Found it ?

Posted by [wunhuanglo](#) on Tue, 21 Jun 2005 16:41:19 GMT

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Definitely an 18 Sound patent for a phase plug - can't say if it's the right one.

Patent

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