Subject: Subwoofer Horn
Posted by Adrian Mack on Wed, 31 Mar 2004 23:04:11 GMT
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Been trying to get a 2.5 meter horn for 18" driver in a 100x90x48cm 'compact' size (for an 18). Thats the horn dimensions... 100cm high, 90cm deep, and 48cm wide. Used a different folding pattern than what mike.e uses to get it more compact.... and can have big back chamber!Assuming that you measure length like this:Then length would be ~2.47m which is about 2.50m. Acoustic length line is the dotted line. I've heard you measure only on 'inside' dimension though? which is this?Here is response: Any comments/suggestions?!Adrian

Subject: Re: Subwoofer Horn
Posted by Wayne Parham on Thu, 01 Apr 2004 00:07:25 GMT
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That's a whopper, but it looks damn good! What woofer did you model it for? There's probably a range of 'em that will work, but which one did you model, if you don't mind my asking? Could you use a 2241?

Subject: Re: Subwoofer Horn
Posted by Adrian Mack on Thu, 01 Apr 2004 01:33:07 GMT
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I modelled it up for the Eighteen Sound 18LW1400. I bet there are a lot of woofers that could be direct substitutes though.... like McCauley or JBL. I'm not at home right now, when I get home I'll model up a few other drivers and see what happens. I have a feeling they will perform very similar.

Subject: Re: Subwoofer Horn
Posted by Wayne Parham on Thu, 01 Apr 2004 01:56:32 GMT
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Looks great!

Subject: Re: Subwoofer Horn
Posted by Mike.e on Thu, 01 Apr 2004 07:00:15 GMT
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I think you'd be very pleased with a sub that goes that low. power with 50wthen use the 1kw lab gruppen on a tumult for the bottom octave.email me the specs and il fold it my way

Subject: Other Drivers and stuff
Posted by Adrian Mack on Thu, 01 Apr 2004 08:48:05 GMT
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Hey WayneJust modelled up a few other 18" drivers on the same horn. I found that JBL 2242, Eminence Omega 18, and Eminence Magnum 18LF show the EXACT same response curve as the 18-Sound 18LW1400 response curve in my first post. I almost thought I didn't change the T/S data in Hornresp, because they model up so idential! Great thing about all those woofers is they all have shorting rings/distortion reduced motors, except for the Omega 18. And these 18's are definitly 'top of the line'. JBL 2241, Eminence Kilomax 18, and Magnum 18HO on the other hand didn't model up so smoothly. And strangely, the response curves all looked the same as each other, all peaking and dipping in the same positions! These woofers which arn't so good in the horn showed a curve like this, the woofers being only 0.5db or so out from each other so I'll post one graph only:I guess its not really that bad. Considering that this is a theoritcal model only, it's bound to perform differently in a lot of rooms, though Hornresp is pretty accurate. Getting back to the 'good' drivers (18LW1400, 2242, Omega 18, Magnum 18LF) if it is desired, then throat size can be decreased from 500cm^2 to 400cm^2 if you want to flatten response by about 1.3db more in the 30-40Hz area. Reponse curve in my first post had a 500cm^2 throat, graph below has everything the same except with 400cm^2. It's not much different from the graph in my first post. Reason why in my first post I posted the response curve which had the bigger throat, is because I think the bigger throat will cause less distortion, which I consider of more importance than 1.3db or so flatter response, which may not even be worth it by the time you consider room modes and stuff. Although 500 isn't that much bigger than 400, so it probably wont do anything to distortion (or much). Either way, they both are good. Anyway - I'm beginning to really like this horn... I think I'll take the plunge and try posting it on AA (hope I dont get any response from that loser Romy). Funny thing is I was just playing with hornresp when I was bored, not doing anything in particular, just playing around with old models I had modelled up in the past. I was just randomly punching in numbers, half falling asleep at 12am midnight. Then I saw the curve looked quite nice with 2.5M! Recently I got a cool CAD program so I could fold the horn myself, so I began playing with that. I wasn't that motivated though considering previous attempts which came out just way to dorky and bulky physically, because it is after all an 18" driver. And 18's need big back chambers (85L on the above model). I thought, the physical area taken by back chamber would be a lot less if I put the driver on top, rather than somewhere in the middle of the horn (like in the horn I posted ages ago using the same driver). With the power of the CAD program I was more than tempted to try, and it worked. Thats how it all happened :p Maybe I should get bored more often, more ideas might come, haha. Adrian

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 10:19:47 GMT
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Looks great! Were those eighth-space models? Really, the 2241 version isn't too bad, and it's a lot cheaper than the 2242. The Magnum series sound just like 22xx JBL's, so that's a good option too. A Magnum 18LF is not much money at all in comparison with the JBL's.

Subject: Re: Other Drivers and stuff
Posted by Adrian Mack on Thu, 01 Apr 2004 10:29:32 GMT
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Yep, they were modelled in eigth space. Theres probably other drivers from other brands too that will work, I just did the Eminence and JBL's though because a lot of people use them here.

Subject: Hornresp Inputs
Posted by Adrian Mack on Thu, 01 Apr 2004 10:33:09 GMT
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I think I'd be pretty happy with 30Hz too. Maybe I'll try putting a high pass filter at 30Hz one day on my sub and see if I notice any difference with music, but I think my room will gain so much on the low end anyway making the experiment not worthwhile. It means the basshorn will have gain on the low end too though :DHere are the inputs:Let me know if you can come up with a better folding scheme!Adrian

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 10:51:14 GMT
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Gotcha. Looks great! I'd go with the Magnum 18LF or the JBL 2242. What's the best deal for you? I assume it's 18Sound?

Subject: Re: Other Drivers and stuff
Posted by Adrian Mack on Thu, 01 Apr 2004 11:04:18 GMT

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Well I own an 18LW1400 so I'm already half way there, or 3/4 in terms of $$$, just need wood! its in the big vented box right now I showed you before.... I like the 18-Sound driver a lot, you probably can tell by now :p I like that there are so many direct drop in's which can be used on this horn.

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 11:44:03 GMT
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Super cool. If you have the driver, your cost now for building a speakers is mostly in your time for making the cabinet. And then the wood too, as you say. Now that I think about it, that's a lot of real estate, so the wood ain't gonna be cheap. But at least you have the woofers.Hey, here's an off-topic thing that caught my interest. I hope maybe you'll have some input.I'm wondering where the onset of non-linear distortion happens from compression/rarefaction asymmetry. Do you happen to know of any references to reliable research data on the subject?I'm guessing it happens when the compression cycle of sinusoidal pressure reaches 1.5 to 2 atmospheres, 'cause that would put the rarefaction cycle between 0.5 and 0.0. This assumes (1.0) atmospheric pressure is the baseline, 'cause I'm wondering where the start of trapped-air distortion and other air pressure related acoustic nonlinearity begins. Since you can't go below 0.0, but you can go above 2.0, somewhere in the 1.5 - 2.0 range must start the onset of asymmetry. I just don't know where it is.Check this out. Let me know if you know of any good data on the subject.

Subject: Re: Subwoofer Horn
Posted by Mike.e on Thu, 01 Apr 2004 12:22:12 GMT
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Hi wayne,i have just the same situation,but my horn MUST fit in my little car! which is only 80cm wide! it seems near impossible to make my jbl fit in there while still reaching 30hz,40hz is definitely possible though :-Slab12 it is!

Subject: Re: Subwoofer Horn
Posted by Wayne Parham on Thu, 01 Apr 2004 13:08:04 GMT
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Put wheels and a windshield on Adrian's horn and you can drive it like a car! You won't need a

flat 'cause you can live inside it!

Subject: Re: Other Drivers and stuff
Posted by Tom Danley on Thu, 01 Apr 2004 14:13:36 GMT
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Hi WayneThe non-linearity you speak of (called throat distortion in horns) is caused by the fact that the speed of sound is temperature dependant (with speed increasing with temp). Imagine a sound wave, the "pressure" half of the wave is actually warmer than the rarified side. AS a result, the "hot" side travels slightly faster than the cool side and so after enough distance (and sufficiently high SPL) the nice sine wave progresses into a saw tooth wave. If I recall, at about 1100 degrees C, the speed has doubled.This was a real problem in the acoustic Levitators I used to work on as once one had a saw tooth (or sufficiently distorted sine wave) then one also produced acoustic pumping (an effect like a fan). These operated in the range of 155 - 175 dB SPL @ 21Khz generally.This effect is also seen in a sonic boom, here, on the leading edges, the air is compressed over 1atm at supersonic flight. Here, because of the same temperature/speed relationship, what finally reaches the ground as radiated sound is also a saw tooth (on the front edge), over all, the waveshape of a sonic boom is like a capitol letter N.Throat distortion is pretty much a non-issue in bass horns though, cone and coil drivers generally cannot produce enough acoustic pressure to cause this.While dozens of bass horns I have measured had sometimes even gross distortion, the driver is the primary source.This distortion is the sum of the VC motor and mechanical system's non linearity.The "bad" effects of the latter can be minimized by choosing a driver with a low Fs which then requires a small Vb to end with the right compliance.Depending on the sealed volume more means that a more linear spring is dominating over the drivers relatively non-linear suspension (by comparison) spring.Generally, stay away from High Fs driver for bass horns if low distortion is a goal.The BT-7's for example of relitively high throat pressure, are the same horn (essentially) as the LAB sub but at full rated power have typically less than 1 ½ % distortion. This on a system having a higher compression ratio than the Lab sub (as the SDL has 2, 15 inch radiators and a much stronger motor). If air non-linearity were a problem for bass horns, it would be here.Even with the LAB12 driver, the LAB sub has measured to have less distortion than any other box tested, even the other low distortion horn, the Bassmaxx.I found the comment of one of your posters to be humorous in that he thought the lab sounded un-musical and preferred the sound of his vented boxes. All of the vented boxes tested so far were VASTLY higher in distortion and less musical when listened to side by side though according to those doing the testing. Your suggestion of a shorted turn being added to the LAB 12 is timely too, this was not possible at Eminance back when I gave Jerry my original request for the lab 12 driver.On the other hand, reducing the distortion a little bit more is not going to make any horn system made with it sound MORE like a vented box or what people are used to given how badly most systems measure at "normal" levels..We use a version of the LAB 12 in several of our products and I should have a sample pair of them (with the Shorted turn) in a week or so.While I never built a LAB sub myself (I was confident enough in the computer program) I do have a similar horn (acoustically) I can compare the differences in.I'll let you know what the difference is if you want.I don't know if McBeans program can predict the Throat pressure but for a bass horn one is safe if you stay under 150-160dB MAX pressure. To put that in atmospheric terms, 132 dB is about 2 pounds per sq foot and 161 dB is about .1 psi if I recall.Cheers,Tom Danley

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 15:04:12 GMT
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Do you have any references to test data handy? I was hoping for maybe some test results that quantified the onset of air-compressibility non-linearity distortion. I'm not sure if it's the same thing as throat distortion or not, but it is from air passing through the cooling vent. This question is purely because of the fact that Jerry's analysis made a 0.75" diameter port possible, and some of us were discussing how much effect this might have. Jerry said he would test them and find out.About motor distortion, I've always been impressed with the performance of flux stabilized motors. They provide about -15dB improvement in 2HD, and it's not just a figure - I find it immediately obvious. You can walk into a room with a sound system and immediately hear whether the woofers are flux stabilized or not. It just sounds cleaner.Back when the LAB12 was first being made, I wondered why it wasn't built with flux stabilization. I think you and I discussed this back then. I got the impression you weren't interested in a better magnetic structure, but maybe I misunderstood you. In any case, that's the point I wanted to make. The motor is responsible for most of the 2HD in the entire system, so to me, it makes sense to make flux as symmetrical as possible if high-output and high-quality are the goals. Since the improvement from flux stabilization is 10dB to 15dB reduction in 2HD, it amounts to a significant improvement around the same magnitude as horn loading. That's like 10x to 35x and sometimes more - Certainly nothing to sneeze at.So I questioned the decision not to use shorting rings in the original LAB12. The Magnum was already in the works, so I wondered why the LAB12 wasn't made with flux stabilization. And here lately, I just thought I'd ask Chris at Eminence about it. In hindsight, I don't know why it hadn't been done before now. But I guess there were cost concerns.Jerry tells me that the flux stabilized woofer is being readied now for testing. If you are expecting such a woofer in a week, then I can only assume that the woofers we've been discussing here are going to be sent to you. Perhaps you will be able to take advantage of them in your BDEAP device as well then.
Flux stabilized LAB12 thread

Subject: Re: Other Drivers and stuff
Posted by Bill Wassilak on Thu, 01 Apr 2004 16:04:18 GMT
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>>Do you have any references to test data handy? I was hoping for maybe some test results that quantified the onset of air-compressibility non-linearity distortion.EV does, EV discovered this on there MTL-4 high cabinets, the 4-10's that were driving the mid-bass horn were developing to much air-compression causing non-linearity in the throat section of the horn and causeing the harmonic distortion to rise dramatically when driven near full power.Bill W.

Subject: Re: Other Drivers and stuff

Posted by Wayne Parham on Thu, 01 Apr 2004 17:51:37 GMT
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Interesting. I didn't really expect to find throat distortion on cone-driven horns, because the compression ratio is low to prevent the cones from ripping. Titanium can stand up to higher compression, but the paper cones punch the voice coil through. I was more concerned about what might happen in the cooling vent, and whether it might introduce 2HD from pneumatic non-linearities at high output levels.This is all in response to the flux-stabilized LAB12 project I asked Eminence to work on. Jerry McNutt said that he and John Sheerin modeled the magnetic structure and found that there were two solutions for putting a flux stabilization ring on the motor. One involves making the vent hole smaller, which might increase power compression and introduce non-linear distortion from the trapped air. The other option doesn't require a reduction in cooling vent size, but it will take a couple months more to develop.If the vent is made smaller, the compression ratio between the cap and the vent will change. The concern is whether or not this feature will adversely affect power handling, thermal compression or introduce distortion. Tom Danley is going to test the flux stabilized LAB12 next week, so we can know the distortion of this version of the woofer. If it works out, perhaps Eminence will make a better low-distortion version of the LAB12 available fairly quickly.If not, the second option is to install shorting rings in the plates, outside the voice coil. It has the advantage of allowing the vent to be made larger. This option will take 6-8 weeks though, so production would have to wait a little longer.

Subject: Re: Other Drivers and stuff
Posted by Bill Wassilak on Thu, 01 Apr 2004 18:24:10 GMT
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>> I didn't really expect to find throat distortion on cone-driven horns, because the compression ratio is low to prevent the cones from ripping. Titanium can stand up to higher compression, but the paper cones punch the voice coil through.I think this is more of a problem pushing low frequencies, that compression ratios come more into play. On Tom Danley's BT-7 I think they have like a 3:1 ratio and when they were in development they had problems tearing cones apart at first, and I've heard other people talk about it when they start going over 3:1 ratios. On Ev's MTL's they crossover at 160Hz but I'm not sure what the compression ratio is on these, but they weren't ripping cones, just causing distortion to rise. After they discovered this they came out with mod kits for them to address the issue which I think was a 1/4" spacer between the 10's and horn's throat to reduce the distortion at the cost of 2-3db reduction in SPL's.I've been following the threads on the new lab 12, but at first I thought you were talking about non-linearity in horns rather than the speakers vent hole.Bill W.

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 19:17:11 GMT
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Aahh, cool beans, interesting story on the EV horns.Are you gonna be at Jim Denton's house on Saturday?

Subject: Re: Other Drivers and stuff
Posted by Bill Wassilak on Thu, 01 Apr 2004 19:31:40 GMT
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Planning on it, don't know what time I'll show up, going to Kidd Rock Friday night so don't know how burnt I'll be.Bill W.

Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Thu, 01 Apr 2004 19:47:53 GMT
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That's cool. A buddy of mine had three tickets to Kidd Rock and he couldn't go so he asked me to sell 'em on eBay for him. I couldn't go either, so I put 'em up and they sold. Pity, I like some of the stuff they've been doing, especially about three years ago.So dude, just chill out and sleep it off. You don't have to be there until 2:00pm, so if you can't make it there by then, I'm gonna razz you for a year.

Subject: Re: Other Drivers and stuff
Posted by Tom Danley on Fri, 02 Apr 2004 13:51:01 GMT
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Hi WayneAside from thumb rule formula linking SPL to horn bandwidth, I have not seen much in print. Most of the experience I have had with this issue was in trying to "fix" it in our levitation sources, ultimately, there is no fix, one simply had to reduce the distance (in wavelengths) traveled at high SPL's. I guess one could say for what we were doing, the answer really was to have a converging sound field that only reached maximum SPL where it was focussed. It was pretty cool though, at the center of focus, the sources could light a cigarette with acoustic friction (at about 165-170 dB)Flux rings had been / are pretty much associated with "more expensive" drivers and the advent of accurate magnetic computer models with experience has made many ceramic structures that were the equal of what one could get with the traditional materials (alnico).On the other hand, as long as the lines of flux are not "pinned" down totally , the magnetizing force in the Voice Coil modulates the set point of the magnetic circuit.The extent it is modulated also is the amount that the magnetic circuits' non-linearity in its BH curve alters the relationship between the two.Interestingly, when I went to work at Intersonics in 1979, the sound

source they were using at the time was called a St Clair (developed by the department of mines I think).It was a bar of aluminum, held at the exact center by a thin flange and driven by a shorted turn.. In this driver, the driven coil is wound around the center pole and the bar is set in motion by the "shorted turn" at one end (turned out of the same bar).I had made several tweeters (a small aluminum dome) with this approach, using the edges of the dome as the S.T. and coil wound on the center pole.These worked fairly well and I thought there was a possibility of making a compression driver this way.We applied for a patent on it but after a while there was a budget cutback and the application was abandoned.Some years later, Tannoy was able to get a patent on it although configured as a "coax" driver.Anyway, back when the LAB sub got started, a shorted turn was not something Eminance did normally. They were well aware of it though, at the Bass list BBQ I held in 1996 where I first met both Jerry and Nick McKinney, we did sit around and talk about it and the St Clair source (as Nick was building speakers with them). Sometime later, Jerry went to work for Eminance.A few years ago, when I asked about making the LAB 12, an ST was still not something that they did normally and as I was asking for a pretty strong motor, there was also a question about how long would it take to develop / cost.Also, when I started that project, I really had no idea that people would be using LAB's in homes so getting the last nth of distortion out wasn't a concern. I just wanted to beat the highly (marketed) thought of bass horns in Pro-sound with something a DIY'r could build. Since there was no way to brainwash people into thinking anything (like the big companies do) , it had to do this on its demonstrable performance.At least so far, nothing they have tested out performs it.I figured this could only happen by following the computer design and not "horn lore" which said one wanted a low mass driver etc. One wants the right driver for the job not a thumb rule here.It sounded enough different than what most were used to be an occasional issue with some at first.Even the fellow on your forum thought it was "un-musical" and wanted it to sound more like a vented box (funny).Reducing the distortion further is not going to make it sound MORE like what he is used to.We use a variation on the LAB 12 in several products also and when we introduced the Bdeap a year ago, immediately about half were going into big home theaters.Because of the high sensitivity and high power capacity, in the home, this kind of horn is just idling away in the home most of the time. For example in my living room, at the listening position (about 15 feet away) the SPL is about 100dB for a 1 Volt input (2 Bdeaps in a corner). Here (at the listening position), things buzzing and rattling in the room etc are the primary sources of distortion, not the speaker.On the other hand, many EQ the system to a far lower cutoff than normal and this really drives the system into potential non-linearity.This is the region I hope may be improved by the ST.I should have a pair of our drivers with the ST next week and I will take some measurements and keep you informed.This is exactly like the driver you are talking about too, a LAB12 with shorted turn (in our case the driver had slightly stronger motor).The Turn (the iron it displaced) was accommodated like you mention by closing the vent dia somewhat so this is a change that needs to be examined carefully.Well, I have to run, a busy day and the kids are home on break.Cheers,Tom

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Subject: Re: Other Drivers and stuff
Posted by Wayne Parham on Fri, 02 Apr 2004 15:05:14 GMT
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Cool beans.I understand the woofer used in the BDEAP horn is slightly different than the LAB12, so perhaps it doesn't make sense to combine the flux stabilized versions into one project. But

they are similar enough the basic woofer structure will be the same, and the efforts to develop them are the same. So in a sense, you and I are cooperating on this one.I do want to address the comments about 20Hz EQ though. Not to pick a fight, but to clarify. You yourself describe the potential of pushing a horn-loaded LAB12 into non-linearity by EQ'ing the bottom end. That's exactly the point I've made in the past, and what I hope to address with the flux stabilized LAB12.Since the woofers in a horn act as direct radiators below horn cutoff, it's really the woofer alone that sets performance limits at those low frequencies. Certainly EQ is an option to bring up the bottom octave, where the horn becomes ineffective. Or if 140dB isn't required and 120dB will do, a smaller direct-radiating package is a viable option and EQ isn't necessary. In either case, having a high-quality subwoofer with a shorting ring will really shine in this application.Horns are great, but if you're looking for operation down to 20Hz, a subwoofer such as this can be used in other smaller enclosure types as well. For maximum power, a horn is the best option. It offers about 15dB greater output above cutoff, which is significant. But the smaller package of using the subwoofer as a direct radiator is a viable alternative, and performance is quite good, particularly at the lowest frequencies.

Subject: Throat distortion, air pressure
Posted by Adrian Mack on Fri, 02 Apr 2004 16:51:27 GMT
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Hi Tom> This effect is also seen in a sonic boom, here, on the leading > edges, the air is compressed over 1atm at supersonic flight. Here, > because of the same temperature/speed relationship, what finally > reaches the ground as radiated sound is also a saw tooth (on the > front edge), over all, the waveshape of a sonic boom is like a > capitol letter N. > Throat distortion is pretty much a non-issue in bass horns though, > cone and coil drivers generally cannot produce enough acoustic > pressure to cause this. When a direct radiator, I agree that a loudspeaker of this world cannot increase the general air pressure of the entire atmosphere very much (which I'm pretty sure step response shows, showing sound pressure when voltage step function is applied). In a basshorn though (or any horn), cant you think of the piston being a moving 'pump', forcing air through the throat? A smaller throat would be creating more compression at the peaks or crests on a sine waveform, and so theres more distortion if air pressure is increased to much due to a small throat (caused by high SPL). On the other hand, a larger throat would create less compression at both low and high SPLs because of less restriction, so less changing in the temperature/speed relationship (causing volume changes to be unequal when pressure is changed), so less changing of waveshape. I dont know if a basshorn has the ability to increase air pressure much past 1 atmosphere, I guess it must compress to some degree though. I think I'm getting mixed up with midrange and HF horn throat distortion though... does one need more acoustic pressure to compress the peaks of a very long low frequency wavelength? Why is this? Is it because, for example a 600Hz wave vs 20Hz wave. The peak area/region on the 600Hz wave is a lot smaller than the peak region on a 20Hz wave, which would be very wide. So at the same SPL level, the compression of air atmosphere in the 20Hz wave is more 'spread out' than on the 600Hz wave, so the speed/temp relationship is not changed as much on the low frequency wave, so distortion doesn't occur until you feed the 20Hz wave a lot more power to get a lot more acoustic power to compress the air to the same level? But on the 600Hz wave, compression is now restricted to a smaller area, so it air pressure is compressed by a greater amount when

played at the same SPL level as the 20Hz wave. I would think then, looking at just direct radiators now, if we had a magical direct radiator which could produce HEAPS of acoustic pressure/SPL, and ignoring distortion caused by the driver itself, the mere unequal compression and rarefaction of air pressure will cause distortion of the sine waveshape all by or in itself. Getting back to the horn now... I'm trying to understand how the throat size distorts the waveshape. I know that it does, but I've managed to confuse myself. Is it because, the throat size itself has the ability to change air pressure? It is the only thing I can come up with that seems to make sense. Amplitude of the pressure wave increases at the throat where air pressure is maximum? Then air pressure decreases as you move away from the throat and down the horn? So the a smaller throat increases air pressure over a larger one, causing more throat distortion/modification of the sine waveshape to a saw tooth wave. But on a basshorn, weather there is a high compression ratio or a low compression ratio, because of the very large wavelengths of low frequencies, you still need a ton of acoustic output for the crest region of the sine waveform to become compressed enough to distort the waveshape? Since the amplitude/SPL of the fundamental decreases with distance, then compression of air at further distances is less than compression of the air close up. One would then consider that this waveshape distortion is not linear with distance, even if we disregard the fact the horn throat changes air pressure itself. EG: Just consider a sine wave travelling outside, tying back with my previous note/example about the 'magical' direct radiator. Maybe I've got this all wrong... you've really got me thinking about this, I'm trying to convince myself to believe that throat distortion in a basshorn is not an issue because it is not there!I've heard of some people breaking their woofer cones from high compression ratio's even if distortion is not an issue, its one reason to keep the compression ratio low. What comp ratio did you use on the labhorn? Have you ever damaged a woofer before because of high comp ratio at high power?> This distortion is the sum of the VC motor and mechanical system's > non linearity. > The "bad" effects of the latter can be minimized by choosing a > driver with a low Fs which then requires a small Vb to end with > the right compliance. > Depending on the sealed volume more means that a more linear > spring is dominating over the drivers relatively non-linear > suspension (by comparison) spring. > Generally, stay away from High Fs driver for bass horns if low > distortion is a goal. I remember you telling me before, the idea is to get the reactances to offset each other, leaving the resistive components to interact with each other. What I am saying, is how can you say a larger Vb dictates that the suspension of the driver is not as linear as a driver requiring only a smaller Vb? So basically, the idea is to get a load as stiff as the throat, but behind the driver instead using a rear chamber - to get even loading on each side, so its more linear on each side, resistive only. Did you mean to say the compliance of the rear chamber Vb should be matched to that of the throat instead and not the driver suspension? As a matter of interest, the rear Vb which cancels or balances out the capacitive reactance from the mass reactance of the throat, may not be the volume which provides the best/most even frequency response, even though it may be the most linear for the driver/lowest distortion combination...I am pretty sure that in smaller box volumes, the air inside it is stiffer (inductive reactance?) which may be needed to balance out the capacitive reactance from the throat. Just 'how stiff' do you need it though? That is hard to know, unless there are formula's around, which there probably are. I think though that to generalize to say that you must have a small rear volume to make the system linear is a bit of a stretch. It could even be made too small...which would not be good, because then the reactances wouldn't balance. The 'right' rear volume may even be relatively large by comparison... How come a driver with lower Fs will end up with smaller rear volume? I would think driver Qts would play the biggest part here...By the way, would you mind checking my horn length in my first post? It is in the 3rd diagram down. I have the horn length measured right down the dead middle of the horn... is this how you would normally measure it? Have you got any comments on horn/path length?

http://www.audioroundtable.com/HighEfficiencySpeakers/messages/481.htmlBTW: It's almost 2am here in the morning now, don't be too harsh on me if this post sounds like baloney :pCheersAdrian

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Subject: Re: Throat distortion, air pressure
Posted by Tom Danley on Sat, 03 Apr 2004 19:26:21 GMT
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Hi Tom>> This effect is also seen in a sonic boom, here, on the leading>> edges, the air is compressed over 1atm at supersonic flight. Here,>> because of the same temperature/speed relationship, what finally> >reaches the ground as radiated sound is also a saw tooth (on the> >front edge), over all, the waveshape of a sonic boom is like a> >capitol letter N.>>Throat distortion is pretty much a non-issue in bass horns though,>>one and coil drivers generally cannot produce enough acoustic>>pressure to cause this.>When a direct radiator, I agree that a loudspeaker of this world cannot increase the general air pressure of >the entire atmosphere very much (which I'm pretty sure step response shows, showing sound pressure .when voltage step function is applied).>In a basshorn though (or any horn), cant you think of the piston being a moving 'pump', forcing air >through the throat? Yes, unlike a sealed tire pump etc however, on the throat side of the radiator, the "pressure" is not proportional to displacement but rather the velocity. This results in the curious situation where if one looked at the points of minimum and maximum acoustic pressure, one finds that instant in time is where the radiator displacement is zero (but has greatest velocity). >A smaller throat would be creating more compression at the peaks or crests on a sine >waveform, and so >theres more distortion if air pressure is increased to much due to a small throat (caused >by high SPL). On >the other hand, a larger throat would create less compression at both low and high SPLs >because of less >restriction, so less changing in the temperature/speed relationship (causing volume >changes to be >unequal when pressure is changed), so less changing of waveshape. I dont know if a >basshorn has the ability to increase air pressure much past 1 atmosphere, I guess it must compress to some >degree though. I think I'm getting mixed up with midrange and HF horn throat distortion though...What your saying is exactly true, a compression ratio increases the pressure in the throat and in any given circumstance that automatically increases the non-linearity of the air.What makes this "more complicated" is that at the pressures a VC driver can produce in a Bass horn, the non-linearity of the air is often FAR smaller than the typical driver motor and suspension linearity.Remember, sound at least the way we deal with it is logarithmic.For example, if one were able to fully modulate one atmosphere, the resulting pressure is 194 dB or so.This is loud, the sound has a pressure of 14.7 psi peak to peak.At 174 dB, the physical pressure is 1.47 psi and in a really high powered bass horn like a BT-7 or maybe a LAB Sub, the peak throat SPL should be in the neighborhood of 157 dB or .147 psi peak to peak.By the time one gets down to just plain "loud bass" one finds that 132 dB is about 4 pounds per square foot of pressure.I guess the point is that in a really powerfull bass horn, one might be lucky to find a peak throat pressure of 1/100 atm peak to peak. This is not enough to be a real problem and was what convinced me to pursue the more linear unconventional styles of drivers for bass horns. . does >one need more acoustic pressure to compress the peaks of a very long low frequency wavelength? Nope, pressure is pressure.>Why is >this? Is it because, for example a 600Hz wave vs 20Hz wave. The peak area/region on the 600Hz >wave is >a lot smaller than the peak region on a 20Hz wave, which

would be very wide. So at the same >SPL level, >the compression of air atmosphere in the 20Hz wave is more 'spread out' than on the 600Hz >wave, so the >speed/temp relationship is not changed as much on the low frequency wave, so distortion >doesn't occur >until you feed the 20Hz wave a lot more power to get a lot more acoustic power to >compress the air to the >same level? But on the 600Hz wave, compression is now restricted to a smaller >area, so it air pressure is >compressed by a greater amount when played at the same SPL level as the 20Hz >wave.For a simple case horn, one finds (for flat power response) the driver displacement increases by 2 for each octave one goes down, for a direct radiator in a sealed box, the displacement increases by a factor of 4 for each octave (until past Fb where the displacement is constant with decreasing F).Throat pressure is constant (ideal horn) and output pressure (power) are constant.A real horn (which is always smaller) usually has more "issues" making some of this hard to see.Further complicating this is the fact that the actual throat distortion is much more of an issue at the top end of the response , not at all the bottom. Here is why (or at least what I see / think).The thumb rule for throat distortion shows the band width being a very strong factor in the result.The reason is that the wider the bandwidth, the slower the expansion (dictated by the low cutoff) is compared to the much shorter wavelengths of the high cutoff.This means the HF signal has to travel a greater distance (in wavelengths) at the higher pressures associated with the slower expansion. With our levitator sources (narrow beam, 21KHz @ 160+ dB), we saw this real time, one could take the mic and starting at the source and moving away say a foot (about 20 wavelengths), one saw the waveshape go from a sine to a sawtooth.>I would think then, looking at just direct radiators now, if we had a magical direct radiator which could >produce HEAPS of acoustic pressure/SPL, and ignoring distortion caused by the driver itself, the mere >unequal compression and rarefaction of air pressure will cause distortion of the sine waveshape all by or >in itself. Yep.>Getting back to the horn now... I'm trying to understand how the throat size distorts the >waveshape. I >know that it does, but I've managed to confuse myself. Is it because, the throat size itself has >the ability >to change air pressure? It is the only thing I can come up with that seems to make sense. >>Amplitude of >the pressure wave increases at the throat where air pressure is maximum? YesThen air pressure >decreases as you move away from the throat and down the horn? So the a smaller throat increases air >pressure over a larger one, causing more throat distortion/modification of the sine waveshape to a saw >tooth wave.Yes But on a basshorn, weather there is a high compression ratio or a low compression ratio, because of the very large wavelengths of low frequencies, you still need a ton of acoustic output for the crest region of the sine waveform to become compressed enough to distort the waveshape?Yes, another way to look at it is "power density" HF horns cover both a wide bw and are physically very small. For a compression driver to radiate say 1 acoustic Watt, that power (pressure) is concentrated into a very small area.For a bass horn radiating 1 acoustic Watt, the throat is tens to hundreds of times larger and so the power density is proportionally less. Add in the narrower BW and one finds the air non-linearity is not a big deal in bass horns.>Maybe I've got this all wrong... you've really got me thinking about this, I'm trying to convince myself >to believe that throat distortion in a basshorn is not an issue because it is not there!I can't tell you what to think but I would say as evidence of what I have described is that if air non-linearity were a problem, it would have been when the measurements for the BT-7's were taken.In that case, they were radiating about 180 acoustic Watts each.>I've heard of some people breaking their woofer cones from high compression ratio's even if distortion is >not an issue, its one reason to keep the compression ratio low. What comp ratio did you use on the >labhorn? Have you ever damaged a woofer before because of high comp ratio at high power?You bet, this was a real problem in the early days of the Servodrives, we installed a window in the side of a box and we watched (in some what horror) as we swept the oscillator up and down at high power and watched the cones slowly fold up like some paper

flower.We came up with a treatment we dip them in which stopped cone failures and makes them strong enough to stand on.The BT-7 has a radiator area of 266 sq ins and throat of about 80 sq ins and the Lab sub has about the same throat area but uses 2, 12inch radiators so it has a lower compression ratio.The Lab 12 has a highly reinforced cone, huge ridged dust cap and a stiffener underneath that so it is not likely to have much "non-piston" motion in use.>> This distortion is the sum of the VC motor and mechanical system's>> non linearity.>>The "bad" effects of the latter can be minimized by choosing a>> driver with a low Fs which then requires a small Vb to end with>> the right compliance.>> Depending on the sealed volume more means that a more linear>> spring is dominating over the drivers relatively non-linear>> suspension (by comparison) spring.>> Generally, stay away from High Fs driver for bass horns if low>> distortion is a goal.>I remember you telling me before, the idea is to get the reactances to offset each other, leaving the >resistive components to interact with each other. What I am saying, is how can you say a larger Vb >dictates that the suspension of the driver is not as linear as a driver requiring only a smaller Vb?It doesn't say that directly but in practice, one finds the air to be a more linear spring than most driver suspensions and spiders. Also, most stiff drivers tend to be of the low Xmax variety as well>So basically, the idea is to get a load as stiff as the throat, but behind the driver instead using a rear >chamber - to get even loading on each side, so its more linear on each side, resistive only. Did you mean >to say the compliance of the rear chamber Vb should be matched to that of the throat instead and not the >driver suspension? As a matter of interest, the rear Vb which cancels or balances out the capacitive >reactance from the mass reactance of the throat, may not be the volume which provides the best/most even >frequency response, even though it may be the most linear for the driver/lowest distortion combination...In a perfect world and in the case of a 50% efficient system, one would want to make the acoustic resistance on the radiator to be about equal to the sum of the mechanical and electrical losses.This condition results in about half the input power being dissipated as heat and the other half as acoustic power.In practice, with a real horn, one would "tune" to get the best trade off in response /low cutoff and possibly efficiency.>I am pretty sure that in smaller box volumes, the air inside it is stiffer (inductive reactance?) which may >be needed to balance out the capacitive reactance from the throat. Just 'how stiff' do you need it though? >That is hard to know, unless there are formula's around, which there probably are. I think though that to >generalize to say that you must have a small rear volume to make the system linear is a bit of a stretch. It >could even be made too small...which would not be good, because then the reactance's wouldn't balance. >The 'right' rear volume may even be relatively large by comparison...The high pass nature of the load and the spring force controlled driver lf response both govern the horn's output. The spring force is the sum of BOTH the driver suspension compliance in parallel with the enclosure compliance.The air is the more linear of the two so I suggest making its contribution larger and the drivers suspension smaller to still end with the needed total compliance.>How come a driver with lower Fs will end up with smaller rear volume? I would think driver Qts would >play the biggest part here...For two drivers of identical area and mms, the one with the lower Fs has a weaker suspension spring and depends more on a smaller box to get the desired Fb.>By the way, would you mind checking my horn length in my first post? It is in the 3rd diagram down. I >have the horn length measured right down the dead middle of the horn... is this how you would normally >measure it? Have you got any comments on horn/path length?
>http://www.audioroundtable.com/HighEfficiencySpeakers/messages/481.htmlI don't know if this is a help but I generally figure that the horn has to end with the same internal volume folded or not when I lay one out. In reality, a bend does add a tiny bit of extra inertia.I had seen your horn in several posts and was thinking of making a suggestion.I try to end up with a minimum of un-used space, looking at the void in the forward end of you box, I can't help wonder if you reduced the

thickness dimension a bit (making the horn take up a little bit more space up and down) if that wouldn't use it up.Or, possibly increase the front to back dimension a bit and make the horn a bit longer which also makes it take up more space (and of course go lower).Please do not take my suggestion as being critical, I encourage you to pursue what ever it is you end up with. Horns can be a lot of fun to design and clearly you have the bug.Cheers,Tom Wayne I have a reply started to you too but I have to run, more Saturday chores.

Subject: Re: Other Drivers and stuff
Posted by Tom Danley on Sun, 11 Apr 2004 17:45:58 GMT
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Hi WayneThe standard Lab 12, the version we use and the shorted turn samples your talking about that Eminance has built are all the same driver with the exception if the dimensions of the center pole and in one case the addition of a shorted turn and in the other a different VC.You could say they were different drivers but unless you took them apart down to the core and measured, you couldn't tell the difference as all the radiator, suspension , frame, physical construction and magnetic parts are all the same. Part of the design (what makes it a LAB 12 and different) here was to make a very ridged cone, one that acts like piston in operation in a horn as well, not just the driver parameters I had specified.My thought in not calling it by an unrelated name (like mag 12 etc) is that one does not see this generally when one say offers some other minor change, say a dual coil version of a woofer with a proven track record like the LAB 12 has. Also since the LAB sub project drove the need and then the design / spec's I gave Eminance for the LAB-12, it is perhaps also a part of the objection that one would simply be taking a unique, successful, proven design, make a small change (that was on the wish list but couldn't have been implemented at its conception) and try to infer it as a fundamentally different driver.Since "MAG 12" is not a new driver design and is identical in every way to the LAB 12 (except for adding the ST), why not just call it the LAB12 ST?This is perhaps just my view, for example, our version of it has our logo and decals and a somewhat stronger motor and different VC, but I still refer to it as our version of the LAB 12 and not something new..So far as co-operating, understand any help I have given (doing the LAB sub project etc) or other things is aimed at the DIY'rs and not part of "my job". It is a somewhat sensitive area too as it is frequently pointed out that my designing things for DIY'rs (like the LAB sub) that may compete with our products at work in not a "good idea". This stuff is my personal interest though and fortunately I am not constrained by the all rules which usually prevent others in my position from participating, now it is only a lack of time that is the problem.I see your forum as a good thing for the DIY community so from that standpoint I am trying to help (like commenting on and refering to your forum on LAB etc) and on this I think we do certainly have common ground.While the Pro-sound guys are happy with the LAB sub and our version of the LAB 12 has worked well in the Bdeap's, I agree too that the driver has other "non-horn" uses, one of the first things I posted about on LAB was that I used the drivers in a vented box for my bass and then in 2002 we came out with the td-1 sub which is a vented box using it which has been well received. There are a few threads on the LAB from folks who did this too.I am Working on a hybrid horn system now using it again, it is a great driver and few have failed in the years it has been in use and it is nice the big E can add a shorted turn now. I am curious to see how much difference it makes on this driver.I wouldn't expect sales to the Pro-sound market to be very large though, the Lab horn "as is" is the lowest distortion (at a given

level) of any of the Pro-sound subs tested, including the other low distortion horn system. "Driven to non-linearity"In practice one finds a loudspeaker has measurable distortion at any level one could drive it at, it then becomes a question of how much is too much or can you hear the difference with and without.Woofers specifically, all produce audible distortion at any level you can hear them at. Dolby Labs found in testing commercial subwoofers some years ago that there were none available to the home market which could even produce an audible 20 Hz at 1 meter and not also have plainly audible distortion components (when taken away).On the other hand, one can measure levels of 10 % or much more on many speakers at low frequencies at modest listing levels (why distortion is often specified only at 1 Watt or other "low" power).The idea in the Lab sub was to make it have as high an acoustic power as possible, to run out of excursion and thermal at about the same time.In the home, this makes for a horn which is literally loafing in the extreme.For example, in my corner I have two Bdeaps, at the listening position, I have a measured sensitivity of 97.5 dB avg for 1 Watt input. The system can handle two or three times the 2000 Watt amplifier I have driving it If you are using something at -30 or -33 or even -40 dB of full power, driver linearity is going to be very good and be low in distortion at any level your concerned with.The math, 2 boxes (2 of the 12's in each box) can handle 3200 Watts RMS in band, and the peaks in that rating are +6 dB greater still (requiring 12.8 KW peak). 1 Watt equals 97.5 dB at the couch with a safe +42 dB of peak head roomNow, want to extend the bottom end a little?Add say +20 dB of EQ which since your dealing with an acoustically small room (at this freq) it is also minimum phase which corrects the response and phase.Now you may have extended the low cutoff an octave or two at the expense of cutting your peak headroom down to "only" +22 dB left (over 97.5 dB).Here is a fellow who has gone perhaps off the deep end in his home theater, look at the measured responses.http://www.avsforum.com/avs-vb/showthread.php?s=4c6ec5466a3c7c6d0bf0174910298bf9&postid=3473618&highlight=bdeap#post3473618Remember the plots for the single LAB sub in half space (which goes down a tad lower than the Bdeap) are nothing like what one see's in a room, these are not like the "bass horns" most are familiar with and neither is the driver or horn alignment.As a direct radiator however, the distortion would (for a given SPL) be much greater both from the added excursion (the Lab horn raises the output about 20 dB vs a direct radiator) and from the fact that a proper horn has an acoustic roll off above its operating band (attenuating harmonics).A horn like the LAB sub or our Bdeap does not just "go away" below cutoff, at an ocatve down from the corner, these horns are still adding about 3 dB over the same excursion as a direct radiator and its low pass acoustic filter (of the horn) also lowers the distortion vs a direct radiator.Got to run now,Tom Danley
EQ'd horns

Subject: B12 Subwoofer Project
Posted by Wayne Parham on Sun, 11 Apr 2004 20:13:01 GMT
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The name "LAB12 ST" would suit me fine, but it may be confused with the existing woofer. I tenatively chose the "MAG12" name in early discussions, making a reference to Eminence's flux-stabilized "Magnum" series. But that may also be confusing since Eminence has introduced a "Magnum 12" midwoofer.It is actually an Eminence executive that has voiced his opinion that "LAB12 ST" and "MAG12" might cause market confusion. I don't believe either name violates any

trademark, but I haven't asked an attorney to research it either, so I don't guess I really know. In any case, it's not the name I'm particularly interested in.I'm thinking about calling the woofer simply B12. The main thing I'm concerned about is its specs. Woofers with ferrite magnets are improved significantly when flux stabilization rings are used, so that's the part I'm interested in. Now it's down to the matter of where to put the ring, in the core or in the plate. Hopefully the first prototype will meet specs with the ring in the core, so Eminence can roll them out pretty quickly.