Subject: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Sat, 26 Aug 2006 17:33:55 GMT
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Some are pretty insistent that heavy cones should be used in basshorns. Others think that lighter cones sound "tighter". I've always considered moving mass as just one of the variables, like rear chamber volume or throat area. Heavy cones have lower resonance but reducing rear chamber volume raises resonance, so it's a balancing act.To say light cones are better or heavy cones are better is like saying stiffer springs are better for a car. It depends on what size car they go in, and what type of ride is desired. That's my opinion. What are your thoughts?

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by wunhuanglo on Sun, 27 Aug 2006 01:14:21 GMT
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It may be that the terms light and heavy are substitutions for descriptions of stiffness - when the throat ratio is too high you can see the compression buckling "star-burst" in the cone, so it makes sense that there's probably a continium of cone defomation that contributes to wavefront distortion.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Sun, 27 Aug 2006 01:38:37 GMT
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Certainly we don't want cone breakup but beyond that, we're also talking about diaphragm mass, suspension stiffness and excursion. One type of driver has a relatively light cone with stiff suspension and short excurision with a lot of magnetic energy concentratd in the gap. Another type of driver has a heaver cone with looser suspension and longer excursion with the coil in the gap.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by wunhuanglo on Sun, 27 Aug 2006 03:03:19 GMT
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What I was trying to say (apparently badly) is that a preference for heavy or light cones may be not related to mass - as you indicate the suspension, back chamber, gap flux can "equalize" performance given different levels of moving mass. What I was trying to suggest is that the

impression that a driver with a particular cone, heavy or light, is "better" may be related not to the moving mass but the inherent stiffness of the cone material or geometry - does that make any sense?

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Manualblock on Sun, 27 Aug 2006 12:05:32 GMT
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How do we know exactly what constitutes heavy or light?

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Sun, 27 Aug 2006 16:23:07 GMT
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Making the cone strong enough to withstand throat pressure without bending or breaking is important, to be sure.As for tuning, high mass diaphragms have low free air resonance. An example would be something like a 12" or 15" car subwoofer tuned to 20Hz or so. Low mass diaphragms have higher free air resonance. Examples would be 12" and 15" drivers with free air resonance around 40Hz and up.One school of thought is to use a high-mass diaphragm in a basshorn with a very small rear chamber to shift resonance up. Another school of thought is to use a lighter cone and to have a larger rear chamber or open back.I've made horns of both types, but some people say one is "right" and the other is "wrong." Bill Fitzmaurice, for example, regularly instructs people that high-mass/low-resonance drivers are wrong for basshorns. Tom Danley preaches the exact opposite. So I thought I'd open a thread for discussion.Personally, I think it depends what one wants from a basshorn. If purely used for subwoofer duty, the high-mass/high-excursion driver is probably a better choice. If used up through the midbass, I'd use a driver with a lighter cone. I'd also fold the horn differently for the two different types, with the subhorn having folds that attenuate higher frequencies but the midbass horn either being straight or having folds that acted as reflectors, directing higher frequencies towards the mouth.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by wunhuanglo on Sun, 27 Aug 2006 17:18:44 GMT
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Unless I simply don't understand what you're saying I have a hard time accepting the proposition that high mass necessarily implies low resonance. Do I interpret your words as comparing similar diameter cones on a beam balance - some impregnated pulp and goop covered cones will be heavier than some thin poly cones for the same diameter? If so, can that necessarily dictate Fs?

With the same surround, the same suspension, the same voice coil and former you can expect the mass to determine the Fs, but it doesn't necessarily follow, does it? The heavier cone could just as well be supported by a stiffer suspension and surround making it a higher Fs driver than the lighter cone, no?It seems to me there has to be a far more complex relationship for there to be a preference; that many other physical parameters have to be considered in addition to mass alone including the combined +/-kX aspect.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by GM on Sun, 27 Aug 2006 19:09:03 GMT
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>Heavy cones have lower resonance.....Greets!Not necessarily:Fs = [(1/Pi)/2]*{[1000/(Mms*Cms)]^0.5}where:Mms is in grams and Cms is in m/N=====>To say light cones are better or heavy cones are better is like saying stiffer springs are better for a car. It depends on what size car they go in, and what type of ride is desired. That's my opinion.=====Yep, it all depends on the desired BW and acoustic power/watt you want. If I only need it to load 30-100 Hz, why force a 40 Hz Fs driver with a 400 Hz HF mass corner to do it?GM

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Manualblock on Mon, 28 Aug 2006 13:51:53 GMT
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Yeah; that sounded a little simplistic to me too.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Mon, 28 Aug 2006 14:24:35 GMT
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Absolutely! Very true.Higher mass results in a lower resonant frequency if suspension stiffness is the same. That was sort of an implication, but maybe I should have been specific.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Mon, 28 Aug 2006 14:27:45 GMT
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Higher mass results in a lower resonant frequency if suspension stiffness is the same. That was sort of an implication, but maybe I should have been specific. As to the difference, it is really a matter of tuning. Some guys won't use anything but low-mass, low-Q drivers in basshorns, others want high-mass, loose suspension drivers.

Subject: It seems that the problem is the rear chamber
Posted by wunhuanglo on Tue, 29 Aug 2006 08:04:38 GMT
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While in theory you can tune the Fh it seems that you're always up against it on the rear chamber volume. You usually can barely fit the driver in the space, so if you need to raise the Fh you're kind of SOL.If you're building a tightly folded horn like the LAB horn it seems that Fs really dictates the feasibility of physically constructing the thing. Whenever I play with Hornresp I always get backed into a rear chamber volume that won't accomodate the driver.

Subject: Re: It seems that the problem is the rear chamber
Posted by Wayne Parham on Tue, 29 Aug 2006 14:18:13 GMT
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That's exactly right. The rear chamber volume sets the resonant frequency along with the mass, because rear chamber volume determines overall compliance.In my basshorn design, I've balanced the rear-chamber and front-chamber with the driver to get better response than the LABhorn, but it does take a pretty small rear chamber to do it. Brad Litz did this too. It's actually slightly larger than what is used in the LABhorn, large enough to build a box around the driver. The frequencies are low enough that everything is pretty large, and even a small rear chamber is big enough to work with.What's really difficult to work with are rear chamber volumes so small that the box has to contour around the magnet. I run into this with midbass horns. On midrange horns, I'm not usually worried about excursion, so I sometimes design them for open backs or large rear chambers, which act the same. I'm not usually looking for LF from a midrange horn. But midbass horns can potentially have cone excursions that make me want to use reactance annulling with a smaller rear chamber. On those, sometimes the rear chamber size required to do that is so small it's practically a sealed back driver.

Subject: Re:On that subject, will there be 9 Pi Bass horn plans soon? nt
Posted by Bill Epstein on Tue, 29 Aug 2006 23:50:18 GMT
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Subject: Re:On that subject, will there be 9 Pi Bass horn plans soon? nt
Posted by Wayne Parham on Wed, 30 Aug 2006 02:26:26 GMT
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Yes, plans will be available soon. There's a general description in the post called "Give us the

Subject: Re: Heavy-cones verses light-cones in basshorns, yes!
Posted by Tom Danley on Fri, 01 Sep 2006 20:59:22 GMT
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Hi Wayne, allThe advantage / reason for using a massive driver is because for a given bandwidth, the heavier / stronger driver has a different acoustic impedance and requires a higher compression ratio. A higher compression ratio means more acoustic power for a given cone excursion. At low frequencies, in horn loading it was usually the case that one runs out of Xmax well before power handling, causing the famous bass horn distortion (like the famous W bin). This was blamed on “throat distortion” but was actually the driver reaching xmax and beyond.Hence using a heavy driver made sense to me here given the available power capacity and the desire to maximize the “undistorted” output..The BT-7 horn was aligned with a 3:1 compression ratio, the Lab-12 was only heavy / strong enough to need about a 2:1 compression ratio in a similar bandwidth and low cutoff.Alternately, if one scales up mentally, one finds the 10:1 compression ratio in a typical compression driver, is needed to get the wide bandwidth from what is (up high) a massive driver also. Cheers,Tom Danley

Subject: Re: Heavy-cones verses light-cones in basshorns, yes!
Posted by Wayne Parham on Fri, 01 Sep 2006 23:21:30 GMT
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For a subwoofer basshorn, I would agree. For a midbass, less so. Kind of goes without saying, if you asked me. But I remember the debates you had with the Edgar enthusiasts back a few years ago, and I noticed that the Fitzmaurice designs are similar so I brought it up here. This hasn't been discussed in a while and some have never considered the issues, others have forgotten them.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by DMoore on Mon, 11 Sep 2006 21:14:06 GMT
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Don Keele Jr. stated that in order to achieve the widest bandpass that a prospective horn driver should (indicatively) have a Qts below .30, which indicates a strong magnet to moving mass ratio; I'm assuming whether this ratio is achieved by using a "light" cone in relation to the mediocre magnet structure or a "heavy" cone and a really powerful magnet structure, it doesn't matter especially, although theoretically the moving mass component will effect the upper bandpass capability, of course.I think that boils down to what you want to do with the Fch that determines the appropriate-ness of a driver for your desired application.Daniel Plach reported that for a front-loaded horn (sealed Vb), the use of a linear motor with a low Fs is desirable, the bandpass being somewhat more limited and subordinate to the efficiency and lower distortion the loading is capable of. He said that the Vb could be practically reactance-annulled (for a Hyperbolic/Exponential flare), the course of which naturally raises the Fs of the driver, and therefore, the driver should start out with an Fs below that of the horns Fc.He also said that for back-loaded horns, the use of a driver with a rising response curve was in order with Fs above the horns Fc, because it could not be reactance-annulled due to tuning requirements (Fr) of the back chamber usually being much lower than the horn's Fc.DM

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Mon, 11 Sep 2006 23:15:57 GMT
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That was my conclusion too. Driver mass, suspension compliance and BL are all tunable parameters that can be used along with rear chamber, front chamber and flare to set a horn for its intended application.There was some debate about this earlier with Danley championing Leach math and woofers with relatively heavy cones and Edgar prefering Keele math and woofers with lighter cones and stiffer suspensions. I tended to see their arguments as flip sides of the same coin but the debate was on, nonetheless. Seems to have been clarified to everyone's satisfaction now.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by DMoore on Tue, 12 Sep 2006 16:44:49 GMT
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Hi, Wayne.I would assume that a 3-octave limited horn would/could "enjoy" a large-mass driver, i.e., it won't matter whether it has a light cone, because it technically doesn't go high enough in frequency band pass to actually make use of it.I would also mention that large-mass drivers tend to heat up the VC (comparitively) more than a lighter assembly MIGHT, simply because more energy is required to move the mass, overcoming inertia and all that. In the case of sealed back

chambers, this could be a potential design consideration brought about specifically by the choice of driver mass and power handling capability, depending on the application, of course. Large SPL requirements would definitely put this consideration on the designer's plate, I would think.Personally, I've always regarded large-mass drivers (i.e., heavy cones) to be more appropriate for direct radiator use rather than used as horn drivers. Sort of a bellweather for me in selecting drivers.In a resistive, pressurized environment such as that presented by a horn throat or more likely, a throat cavity opening, will naturally decrease the cone excursion to a great degree, and hence the potential for cone deformation is severely reduced. I tend to completely discount cone deformation as an important consideration in horns for this reason.I think the "old guys" had it right the first time. I look for horn drivers with relatively light cones and large BL's and the lower Qts, the better, but then I'm going for 4 octaves or more, too.Dana

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Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Tue, 12 Sep 2006 19:59:28 GMT
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I understand your position. All the midbass horns I've made were designed to be used over a fairly wide band, just like midrange horns. So I've tended to use drivers like JBL 22xx series parts, which are high BL, low mass speakers. I've made 80Hz horns, 60Hz horns and even 40Hz horns that way, each designed to cover at least a decade. But if I only want to cover the subwoofer range, under 100Hz, the low-fs drivers make some sense. That way I can take advantage of reactance annulling at VLF. Basshorn subs need all the help they can get, because they're never really large enough.

Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by DMoore on Tue, 12 Sep 2006 23:29:14 GMT
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That is exactly my opinion, too.It depends on the bandpass of the horn.That's alot of typing to arrive at that, I should learn to be more concise!Dana

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Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by DMoore on Tue, 12 Sep 2006 23:32:09 GMT
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One more thing - what effect on moving mass do "shorting rings" have?Presumably, they only take effect on the upper-and-mid-bass freqs, so what about sub-horn (less than 3 octave) use?Dana

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Subject: Re: Heavy-cones verses light-cones in basshorns
Posted by Wayne Parham on Wed, 13 Sep 2006 04:47:59 GMT
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Shorting rings do nothing to affect moving mass. They do decrease and stabilize voice coil inductance, which is useful for extending HF response, among other things. They also reduce flux modulation, which reduces distortion.I really like drivers with shorting rings, because one that's properly made will reduce harmonic distortion 15dB or more. That's a huge improvement. But they don't work very well below about 100Hz. Theoretically, one could be made that reduced distortion at very low frequencies, but it's difficult. The ring has to be large, and that takes away from magnet space. From a practical design standpoint, it becomes prohibitively impractical to design a subwoofer with an effective shorting ring. That's why you see other technologies employed, things like differential voice coils and other forms of push-pull drive.Push-pull drive reduces even harmonics, and it works best at low frequencies. So where shorting rings lose their effectiveness at the bottom end, push-pull drive starts to work its best. Push-pull drive only works on even harmonics, but folded basshorns with limited bandwidth will attenuate higher harmonics. For example, if a basshorn is designed to operate to ~100Hz, then the third harmonic of a 35Hz signal is at the edge of the stop band. Second harmonics are cancelled by the push-pull drive and third harmonics are reduced by being out of the passband. Fourth harmonics are cancelled by both the push-pull drive and being even further out in the stop band. Of course, higher harmonics are reduced even more.
Push-pull verses shorting rings