Subject: Horn flare shape response question
Posted by Chris R on Mon, 06 Jun 2005 23:51:17 GMT
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Wayne, anyone,From another news group I followed a few links to some huge basshorns, and one of the comments I read in the text made referenceto flare shape and how sharp the low end cutoff was. The statementwas that exponential flares have a much sharper cutoff than conical.Any comments?Chris

Subject: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 07 Jun 2005 04:45:41 GMT
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Before remarking about flare shapes, I think it is important to briefly mention the fact that a room's corner expands as a conical horn from its apex, and becomes a parabolic expansion after that. If you start at the floor apex, it is conical until the ceiling is reached, and that's where expansion begins to form a parabolic shape. This forms a horn with 9dB DI, all by itself. It is the only thing large enough to provide directionality for bass frequencies. That's significant; In most cases, it has more of a positive effect than the ducts within the basshorn cabinet.Whatever shape a basshorn aproximates, one can make the observation that many basshorns use nearly straight ducts with very little flare. The room outside the horn becomes one of the most important features of the horn. Ducts inside the horn are just the initial expansion, sort of part of the throat.Some people approximate an exponential/hyperbolic expansion using two or three conical sections to make a basshorn. That's fine, but then the room itself forms the final flare, and it is always the largest part of the horn. So I think it is important to examine the horn at that level of detail. Rather than calling it an exponetial horn and modeling it as such, I think it makes some sense to at least investigate it as a series of conical or parabolic sections.Another way of looking at it is as a tapered pipe or transmission line. On casual inspection, this model appears to show some of the same features. A straight flare with shallow taper is a transmission line; They're one and the same thing. And if you look at a basshorn, that's what it is too.What brings me to this line of reasoning is the fact that all moderately sized basshorns are reactive down low. They really don't act like horns in the range they're designed to be used in. The first couple of octaves are almost always highly resonant, more like tapered pipes than horns. By the time the horn becomes acoustically resistive, it is crossed over, handed off to the midrange or midbass system.
Basshorn or Transmission Line

Subject: Re: Basshorn or Transmission Line
Posted by Chris R on Tue, 07 Jun 2005 14:07:55 GMT
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I guess I understand what you are saying. This would apply tobass horns in homes. That would sort-of imply that bass horns(excepting corner horns) are not particularly useful in a homeenvironment.This is what I was talking about.
http://www.scrounge.org/speak/burwenhttp://www.royaldevice.com/custom.htmChris

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 07 Jun 2005 21:27:37 GMT
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When you're talking about horns that are large enough to be of wavelength proportions, then the peaks down low are much smoother. It acts like a horn at lower frequencies, and less like a tuned pipe. When the mouth is truncated for space reasons, the device becomes a pipe. The mouth expansion is needed; That's key to being a horn.As for the overall shape, generally tighter flares are more efficient and operate to a lower cutoff point. The range goes from hyperbolic to exponential to conical to parabolic. Hyperbolic horns have long narrow throats that expand very little until the end. Parabolic horns open widely at first, but then expand less and less. Conical has straight side walls and exponential is in between. Hyperbolic is the most efficient but creates the most throat distortion. Parabolic makes the least distortion, but offers little in the way of efficiency.I think it is also important to look at the directionality, because that is one of the features of a horn. Horns act as resonators, velocity/pressure impedance matching devices and energy concentrators by way of introducng directionality via contstrained space. The combination of effects is what sets the overall performance of a horn.For example, a conical horn is pretty simple in that the walls are straight. Essentially, the energy pattern is set by the horn walls and it is basically uniform for all frequencies. So the output of the horn is uniform throughout its radiating angle which is set by the wall angle. Frequency response is set by the output of the driver. The horn is really just a contstrained space, with some pipe modes down low. Exponential and hyperbolic horns have curved walls, so their directionality changes with frequency. They tend to load lower, and because of collapsing directivity, the on-axis output is increased at high frequencies too. So exponential and hyperbolic horns tend to modify driver response more than conical horns do.

Subject: Re: Basshorn or Transmission Line
Posted by Cal on Tue, 14 Jun 2005 05:36:18 GMT
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I have been, um, "lurking" for some time here, have read and downloaded and pondered. This last interchange between yourself and Tom Danley aroused my enthusiasm, and so I post. The resonant nature of horns around cutoff, become like pipes, I can see it! Reactance of horns in Hornresp at cutoff and above, makes me think of Augspurger and King, not that I understand those guys, either!! So sweet!! So much fun.Please accept my thanks. You are quite a fellow.A while back you talked about cooling bass horn drivers by pumping air with the driver vents. I have thought about this also. Mr. Danley had reservations about drivers pumping air for cooling on a LAB posting, and scared me off some. I also wonder if the inertance of a long cooling tube system would imply a very low frequency low pass filter, maybe a serious impedance mismatch, so not pumped well by the driver without a series resonant volume. (You want inches per second of air flow, direct current!) Could be the compliance in the driver cooling passages would work, but the business is beyond my grasp. I think that the system would be like this, anyway, and so have to be made broad banded in order to work. Makes me realize my limitations even more than usual!! The check valves I can do, their acoustic behavior I can't!!Anyhow, I think a heat pipe like arrangement using aftermarket automotive "oil cooler" heat exchangers, filled with a convenient refrigerant, an alcohol maybe, gravity circulated, an orifice to control the liquid phase flow rate, fans on both hot and cold ends, etc. could be made to work. No compresser needed, heat is flowing down hill not up, maybe viton hose for connections, 12v. fans, etc. Have to be careful about vibration causing metal fatigue in those driver back chambers. Might have to use aero parts. Thoughts?

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 14 Jun 2005 07:46:56 GMT
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We're still working on the cooling system. Actually, I was busy doing other things during the whole first quarter of 2005, so it was on hold because of me for a while. But we're back on track now and I expect to have some samples pretty quick.Danley uses a cooling system that has a fan connected to the signal line. As I see it, this has its own set of advantages and disadvantages. It provides additional cooling when needed most, by virtue of the fact that the drive signal is also used to power the fan. So the fan won't spin until the drive current is relatively high. That's a simple setup and pretty cool, no pun intended. But the disadvantage as I see it is that the speaker output circuit is polluted by the presence of rectifiers and fan brushes and windings. In a prosound environment, that is probably not as much an issue, but I still think I'd prefer to use the speaker motor itself as the air pump. The linear motor is pretty strong, and it provides a pretty good blast of air that could probably be better utilized for cooling.You're right that the addition of ducting changes tuning, at least on drivers as they are made now. There is no seal between the area under the voice coil cap and the area behind the cone, so there is communication through the gap, a small pressure leak.A woofer could be made with a rubber spider that sealed these two areas, and then the pumping action of the cooling system I propose could be greatly improved, making a very efficient pump. Even then, the volume of air behind the cap would still affect the woofer's compliance if it were made small enough. But a woofer sealed this way could be used to form a much more efficient air pump when used with valves, and the vent could be ducted to free air so that the air behind the cap didn't make any impact. With no vent back pressure, the rear chamber could be tuned solely with the chamber behind the rear of the cone.Existing woofers aren't sealed this way, so the only solution is essentially a lossy pump. Also, since there is some pressure exchange between the area behind the cap and the area behind the cone, both of these areas become important to cabinet tuning. When they are both in the same chamber, it doesn't matter much but if the vent is ducted into an intercooler, it does. Some testing is required to knowm how much shift is produced when the intercooler is connected. But it is a pretty simple procedure. Just measure the shift in fb with the intercooler connected and displace some volume

behind the cone to compensate. You're essentially adding rear chamber volume by having a volume of air in the intercooler, so if rear chamber volume is critical, it must be reduced to compensate.I'm pretty comfortable with this aspect. The new thing that has presented itself is the fact that there is not only a balance of pressures that comes into play for cabinet tuning, but also a balance of pressures that affects cooling airflow. The whole purpose of doing this is to provide more cooling airflow and more radiating surface area. But if the cooling system is too small, then pressures in the system will tend to reduce airflow in the ducts. There may be pressure instead of flow if the system is too small. My expectation is that if pressure behind the cone is as high or higher than pressure in the ducts, then the cooling system will probably work well. But if cooling vent pressure is higher, then it will probably start to choke the system. So that is another thing to consider besides acoustic tuning.
Rear chamber volume / Cooling vent volume

Subject: Re: Basshorn or Transmission Line
Posted by Cal on Tue, 14 Jun 2005 11:36:00 GMT
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Thanks for the reply, see you are awake in the middle of the night, also."But if the cooling system is too small, then pressures in the system will tend to reduce airflow in the ducts. There may be pressure instead of flow if the system is too small."With you on that. Call the cooling system an inductor with series resistor and parallel capacitor resonating at a low frequency. The resistance will increase with Reynolds number and impedance with pumping frequency. This means the flow will reduce with increasing driver frequency and rate of change. Inductive. Pulses in the air flow will result in rapid changes in turbulence, Reynolds number changes, making more drag as the pressure changes at acoustic rates. You need a steady air flow to get any kind of mass transfer through this thing. Pump the air into a liter (maybe bigger) tank then through the cooler, kind of a capacitive input power supply filter, a low pass filter, a balance to the high tubing inductance.This is the same thing as your statement about the system acting as a choke on the air flow if the system is too small, as in too small diameter tubes, too closely spaced plates, etc. We are looking at several feet of 1/4" ID tubing here, very low cutoff frequency, a wave guide, I guess. Nasty math, there!! Please, no!!Figure how much air flow, filter out the sound, go for a Reynolds number of about 2500, should work, seems to me!! Probably need some measurement of flows with no pressure fluctuations and with the actual horn application. Bubbling air into an inverted 2 liter soda bottle in a bucket of water might work for flow measurement. Regular u-tubes for pressure.This tube is like a very long very tiny reflex port. What do you think?All of this stuff is why I have been thinking about heat pipes. Two little heat exchangers, two fans, some tubing, and cool to within maybe 20 F. of ambient dry bulb.

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 14 Jun 2005 11:44:41 GMT
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The biggest challenge has been the valves. Can't use flapper valves because we don't want anything flapping, and we don't have a tight seal between the areas behind the cap and cone. We could have still used a pair of valves, one on the vent and another on the cabinet to introduce unidirectional flow, but that would have screwed up acoustic tuning parameters. So we've settled on partial cone inserts that tend to be more restrictive to flow in one direction than the other. We use a pair of them to convert the single vent to an input and an output line.

Subject: Re: Basshorn or Transmission Line
Posted by Cal on Tue, 14 Jun 2005 12:27:46 GMT
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"partial cone inserts that tend to be more restrictive to flow in one direction than the other"You are not talking about valves, right? The cones trip the air flow in one direction and not in the other? I never thought of that. Sweet. Low pressure, though?For valves I was thinking flappers. They have to be carefully made or they will break unpredictably. Metal is best for heavy use, and this gadget is heavy use. Beryllium copper, about 0.010 thick.Thanks for the talk, very enjoyed. Have spent a lot of time looking at the LAB horn, very interesting, the more you look the more you see. Really enjoying your crossover paper. Makes me feel smarter than I really am!

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 14 Jun 2005 22:40:08 GMT
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That's right, no moving parts. The pressure differential is low, but flow is more restrictive one way than the other, so it creates unidirectional flow. There are an assortment of flapper valves we could have used, and a variety of opening pressures. But the valves we chose don't seal, they work on a pressure differential instead.
