Subject: Folded horns - W verses equiangular spiral
Posted by Wayne Parham on Tue, 11 Jan 2005 13:37:03 GMT
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I've noticed on several forums lately that a new popular opinion is forming. The "W" fold was probably the most popular basshorn shape since the early days of the Klipschorn in the 1940's. But lately, I see more and more references to them being worse than direct radiators.I've always folded using an equiangular spiral but mostly because it allowed smaller turn angles. If crossed over low, it seems to me that the angles wouldn't matter much. As long as the horn was used at frequencies below 1/4 wavelength of each section, and as long as the horn is braced well, can you see any reason why a spiral fold basshorn would outperform a "W" fold? If the path length is the same and the area expansion is the same, it sems to me that performance would be the same at low frequencies. I would think the main deal is packaging and layout if all other things are equal. Could the preference be a new misconception?Thoughts anyone?

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Bill Wassilak on Tue, 11 Jan 2005 15:38:15 GMT
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>>I've noticed on several forums lately that a new popular opinion is forming. The "W" fold was probably the most popular basshorn shape since the early days of the Klipschorn in the 1940's. But lately, I see more and more references to them being worse than direct radiators. That's bull, a folded horn will always out perform a direct radiator as far as lower distortion and more SPL's go. They just won't go as low in freq as a direct radiator can with out becoming massive. And there's tests out there that will prove it.>>can you see any reason why a spiral fold basshorn would outperform a "W" fold?Possibly depends on what the x-over freq is. A "W" fold it seems to me can throw out more mb gack if you want to call it that, than what a spiral horn would because of the harmonics and the way the horn path is laid out. A spiral horn has more turns to go through so some of that gack gets attenuated going around more corners.>>If the path length is the same and the area expansion is the same, it sems to me that performance would be the same at low frequencies.It should be.>>I would think the main deal is packaging and layout if all other things are equal.That's true.>>Could the preference be a new misconception? Sounds like somebody's trying to yank-yer-chain.Just my thoughts on the subject.Bill W.

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Wayne Parham on Tue, 11 Jan 2005 16:10:15 GMT
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Hi Bill,Have you seen the posts I'm referring to? They're all over prosoundweb and other places. I mean, the spiral fold is fine and I like it. It lends itself well to long path length for a box 'cause

you're going around four+ sides instead of back and forth three lengths. The curves have smaller angles. But I don't see any reason why people might consider a "W" fold old fashioned and think of a spiral as somehow cutting edge. Seems more like pulley verses gear than pushrod verses OHV.Wayne

Subject: Re: Folded horns - W verses equiangular spiral
Posted by akhilesh on Tue, 11 Jan 2005 19:40:30 GMT
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HI Wayne,OF course I am no horn expert, but maybe it's because spiral horns are more expensive to build? DIY can't maybe do it as easily as a W/ Just a conjecture (i'm even less of an expert on wood working than horns).-akhilesh

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Wayne Parham on Tue, 11 Jan 2005 20:20:32 GMT
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Yeah, I dunno. I don't really think either is any harder to build but maybe. Personally, I have no preference either way. I liked the spirals because they had smaller angles in each fold, but that probably doesn't matter at very low frequencies. The path length is an issue though, maybe that's a slight advantage for spirals in rectangular boxes. The "W" fold cabinet has to be deeper to get the same path length. I guess the same could be said of the "Z" fold too.

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Mike.e on Wed, 12 Jan 2005 07:23:00 GMT
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Hi wayneI found that the Z fold was the easiest,I didnt ever attempt a W horn,because my ones tend to have long paths and small mouths.I like the Z fold aswell due to the fact that only one panel requires 2 critical mitres on it,and all the mitres(4) are easy ones. Also driver access is good,but the rear chamber size tends to be good for the prosound woofers being large.Perhaps the W/C still rules for short paths?

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Wayne Parham on Wed, 12 Jan 2005 10:58:57 GMT

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Hi Mike,Yeah, the "J" or "C" fold are still popular, especially with the single driver crowd. It's an obvious layout for their back-loaded horns, just like prosound "scoop" cabinets. I'm just thinking outloud here, because I've been seeing a lot of negative references about "W" horns lately.I've been working on the cooling system for a large basshorn, and the runs for the cooling lines would be cleaner if the horn were made with a "W" fold. It has hoses that go to a little radiator, and those could be easily mounted on the back of the horn if made a "W" shape. But the horn would have to be real long if folded as a "W", so I'll probably make it a spiral. Or maybe the "Z" fold like you do would be good too.I'll focus more on the horn layout once I have the cooling system done. Right now, I'm testing to know how much volume will need to be in the cooling lines. They form a part of the rear chamber, so this is kind of important. We're still testing to see just how importtant. But once that is done, I'll want to make a horn that is a convenient size and easy to build and service with those cooling lines included.I think the alignment of a basshorn - things like its throat, mouth, expansion and front and rear chambers - are more important than its configuration. The layout is more a function of real estate than of performance. But I thought I'd throw this out there to see if there were any other opinions.Wayne

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Subject: please reference the tests
Posted by Earl Geddes on Thu, 13 Jan 2005 13:11:30 GMT
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"That's bull, a folded horn will always out perform a direct radiator as far as lower distortion and more SPL's go. They just won't go as low in freq as a direct radiator can with out becoming massive. And there's tests out there that will prove it."I have never seen a real advantage to LF horns - and the disadvantages of internal resonances from the folds, etc. is obvious. Please give a rference to the "tests" that prove your position.Of course your statement is rather general and ill defined. Do you mean "outperform" in general or that a specific driver in a horn will outperform the same driver direct radiating. Because to the first point, I don't agree at all. I can always find a bigger driver in the same size enclosure as the horn that will produce as much SPL and low distortion as another driver with a horn. To the second point, an Acoustic Lever will always outperform a horn in this regard - higher SPL, lower distortion for a given driver in a given enclosure volume - so give me the lever, not the horn.

Subject: Re: please reference the tests
Posted by Bill Wassilak on Thu, 13 Jan 2005 13:56:37 GMT
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Below is a link where Servodrive did a test and put the results on there web page, I can also dig up sheets where they did the tests on there old TPL series of subs where they compared the standard reflex vs a regular "W" folded horn I forget if was loaded with 4-15's or 4-18's vs there

servodrive, and both horn loaded enclosures were still lower in distortion than what the reflex was.Also could you send a link to your web site I'd like to read about this Acoustic Lever your talking about. I've heard you mention something about it on another board.
Servodrive

Subject: Re: please reference the tests
Posted by Wayne Parham on Thu, 13 Jan 2005 20:16:47 GMT
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I see both sides here, actually. I'm a big proponent of horns and I know Earl is too. But for hifi useage, basshorns are limited by size.Of course, they gain some from corner loading and room gain but still, there are issues both pro and con, mostly related to the fact that a portable basshorn is limited in size to something well under wavelength proportions. If built-in to the structure, other possibilities open up but that's a rare installation indeed. In most cass, basshorns are much smaller than wavelength scale.This is the prosound forum, and I was really talking about prosound applications when I posted this. The goal is SPL and quality is important, but flat response isn't really on the menu. I still prefer to have distortion and compression very low and as flat response as possible, even if multiples are required. The goals are similar, but emphasis is on output. Anyway, I was really looking for strenghths and weaknesses of various folding paterns, if a basshorn is a given. I'd also like to make the assumption that horns have the same properties of length, area, expansion rate, electromechanical parameters and front and rear chambers, so that the comparison remains solely that of folding patterns themselves.But I like the discussion of the strengths and weaknesses of basshorns in general too. I realize the limitations of them at the deepest frequencies, and don't consider them to be without fault. So I've opened a thread called "Basshorns - Pro and Con" in the High Efficiency forum. We can discuss the more general basshorn matters there.

Subject: Re: please reference the tests
Posted by Earl Geddes on Thu, 13 Jan 2005 21:33:14 GMT
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The link does not show measured data only an estimated comparison. And it is not the horn that yields the efficiency increase in this comparison, it is the nature of the rotary motor structure. The rotary motor is far more efficient than a moving coil motor - thats the point. The horn loading has almost nothing to do with the comparison. The rotary motors downside is frequency response - it has a very limited bandwidth capability. Sorry, but your reference does not support your claim.The lever is not really shown on my site, but is well described in various AES and SAE papers (see my resume for references). The bottom line is that a horn increases the acoustic coupling as the square root of the mouth to throat area ratio, but a lever does this as a direct ratio. So with an area ratio that would double the output due to the horn, the lever would quadruple it. In reality the two things are hard to compare because they both have completely different sets of

tradeoffs and problems.But I stand by my statement that I do not see the advantage of horns at low frequencies.

Subject: Re: please reference the tests
Posted by Wayne Parham on Thu, 13 Jan 2005 22:55:40 GMT
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Do you attribute the apparent gain of a horn to its focused directivity or do you consider it to be an impedance matching device? Maybe a little bit of both? Or would you consider them to be two ways of saying the same thing?

Subject: Re: please reference the tests
Posted by Earl Geddes on Fri, 14 Jan 2005 02:49:36 GMT
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Tough question.I am not exactly sure. I have thought about this, but never really decided. I lean towards two ways of saying the same thing.

Subject: W verses equiangular spiral
Posted by Bill Fitzmaurice on Fri, 14 Jan 2005 17:17:32 GMT
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I use what works best for the intended application. The W has the properties of smaller cross-sections and a single bend, which if configured with concentric rounded pathways can allow passage of mid and even high frequency waves relatively intact. But it also has a shorter path length capability from a finite space than a sprial. These properties make the W well suited for midbass and wide bandwidth applications, not so great for low bass applications, and that's why I use it in my wideband designs. A spiral is far more difficult to construct with concentric round bends, so it's not a good candidate for wideband use, though as Western Electric proved 70 odd years ago it can be done. But as a spiral allows the longest possible pathway from a finite box size, and complicated reflectors and rounded bends matter not below 200 Hz or so, it makes sense to go spiral for pure basshorns. The KHorn seems to make the case for the W configuration for a basshorn for corner placement, but I've found that even there a spiral horn has the advantage, as the spiral configuration will allow a far smaller box for equal or better result.

Subject: Re: please reference the tests
Posted by pgolde on Fri, 14 Jan 2005 18:48:37 GMT
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Does the acoustic lever even exist outside of your papers and models?

Subject: Re: please reference the tests
Posted by Earl Geddes on Fri, 14 Jan 2005 19:45:45 GMT
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It has existed and it will exist.We built several of them when I was at the car companies. I had discussions just last week in LV with a major company who wants to start making them.

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Disco Stu on Mon, 02 May 2005 21:59:59 GMT
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Its all to do with evolution. Nowadays people want more more more. More efficient drivers, more efficient cabinets, etc.Some horns particularly those which are W folded have a relatively short horn length for mouth area. They are often large meaning that low cutoff frequency can be achieved often with only 2 boxes rather than 4 or 6. These days people will use more cabinets to get more volume as this is what is demanded. Therefore it makes sense to make smaller cabinets which on their own have limited extension but when used in the proper quantity end up being both lower and louder than old designs like w bins because the mouth area is larger and the horn length is longer.Stu

Subject: Re: Folded horns - W verses equiangular spiral
Posted by Wayne Parham on Tue, 03 May 2005 15:43:29 GMT
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Yeah, I think that the main thing with the spiral is length. If you start at the center and spiral around the cabinet, you can have length of approximately three times the height of a square box, or maybe a little more. If you do a W fold inside the same square box, then you'll have length of something between two and three times the height. The W fold tends to ofer more cross-section area and the spiral offers more length, but you can squish it around in other ways too.

Subject: Acoustic Lever
Posted by Wayne Parham on Tue, 03 May 2005 16:04:24 GMT
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I saw your Acoustic Lever in your book, "Audio Transducers" and it is an interesting concept. But I don't think many people here are familiar with it. Would you care to show a diagram here, and possibly describe how it works?Your illustration in the book was enough for me to see what you are trying to achieve, and you provided a cursory explanation but you really only dedicated a couple pages to the subject. That may be all that is required to conceptualize it mathematically, but I'd like to see it explored in more detail.My hunch is that it would be best used in bass subsystems, because of its mass. In that regard, it seems like a relatively small area radiator could be coupled to a much larger radiating lever membrane, on the order of areas similar to a basshorn. That might provide the efficiencies of a horn, but without the peaks from being undersized as basshorns almost always are. It has very intriquing possibilities.Might be worth asking Eminence to build one, since they are setup to do it. Then again, maybe you can get a better deal through your contacts at B&C. But either way, I'd love to see tests of a few samples made with various size primary and secondary diaphragms.

Subject: Re: Acoustic Lever
Posted by Earl Geddes on Tue, 03 May 2005 16:37:32 GMT
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Thanks WayneThe Acoustic Lever has been seen before as what was called an "augmented Passive Radiator". It basically has two cones, one larger than the other. As an electrical circuit element it is a transformer and as a mechanical device it would be a lever. It takes in a pressure and volume velocity and outputs a pressure, but with a larger volume velocity than the input (assuming that the output is the larger cone). So it is a volume velocity amplifying device, or impedance matching, whichever you prefer. In the form where all of the sound is forced to go through the lever, it is patented. The prior art all used the lever as a parallel element to a direct radiator.A lever can produce 6 dB (or more) enhanced acoustic pressure than the same driver in any other enclosure configuration. It takes a little more cabinet volume to do this than a closed box, but nothing like the volume required for a LF horn.You wrote:My hunch is that it would be best used in bass subsystems, because of its mass. In that regard, it seems like a relatively small area radiator could be coupled to a much larger radiating lever membrane, on the order of areas similar to a basshorn. That might provide the efficiencies of a horn, but without the peaks from being undersized as basshorns almost always are. It has very intriquing possibilities.You are right on the money here. The concept is low frequency limited and does work best for a woofer or sub because it is enherently band limited - more so than the horn. As a transformer it transforms as the ratio of the areas of the input and output cones. A horn is also a transformer, but it does so as the square root of the input and output areas. For small ratios the two work pretty much the same, but for a ratio of 2:1 or more the lever is much more efficient than the horn. This is one of the reasons that I often state that I can see no advantage to a LF horn. Levers work a lot better.You wrote:Might be worth asking Eminence to build one, since they are setup to do it. Then again, maybe you can get a better deal through your contacts at B&C. But either way, I'd love to see

tests of a few samples made with various size primary and secondary diaphragms.Anybody will make levers for me - if you pay them!! but nobody seems to be willing to build a lever without a great deal of front money. Finding someone to make the levers is not a problem, but making a business case for doing so is.The problem goes like this. I am now convinced that in small rooms the LF problem is best solved by many small inexpensive lower output woofers placed arround the room. Levers are hard to make small so they favor the single larger woofer approach - not what I recommend. In a large venue, like Pro sound, the lever is ideal, but no one has yet shown an interest in building one for this application and I am not in that business.When I was at Visteon we built lots of prototypes and this work was all published, mostly in SAE. The bottom line was that it all works as claimed The catch 22 is that no one wants to make a lever product without consumer demand and consumers don't demand what they don't know exists. I am much more interested in my Summa Loudspeakers at the moment to divert attention rom this project to build some levers just for demo's.I have always offered to help anyone pursue this, but no one has come forth.

Subject: Re: Acoustic Lever
Posted by Wayne Parham on Tue, 03 May 2005 17:56:39 GMT
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Yes, you're right that the OEMs need money to produce a prototype, but some are more willing than others. I think you might approach Eminence with this, as they might be willing to do something with it at low cost. I seem to recall Tom Danley saying that they made the baskets and cones for the prototype of his Contrabass device. All Danley really needed was the diaphragm and suspension hung on a basket, since he used a belt to drive the cone. So maybe they could provide something like that for you. A modified basket could be fabricated pretty easily in the machine shop and a couple of cones could be attached using existing suspension parts. Seems like it would be easy to make 'em with 6", 8" and 10" primaries, and 12", 15" and 18" secondaries. Just a thought.

Subject: Re: Acoustic Lever
Posted by Earl Geddes on Tue, 03 May 2005 19:28:46 GMT
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WayneAs I said, getting the levers made has never been the issue. I can do it without trouble. Its the rational for making them that is missing. The technology has been proven, etc. Until there is a customer, what's the point?

Subject: Re: Acoustic Lever
Posted by Wayne Parham on Tue, 03 May 2005 20:09:23 GMT

Maybe a next product in your Cum Laude line? That's what I was thinking of anyway. Probably just getting ahead of things, that's all.

Subject: Re: Acoustic Lever
Posted by Earl Geddes on Tue, 03 May 2005 20:19:55 GMT

WayneMaybe you missed my comment in an earlier post, but I don't think the lever fits in with Summa's focus on small rooms (see earlier comment).Duke and I have talked about this at some length because we know that we need a subwoofer in the line. But I want to do the right thing not just the new thing (even if I do own the patent).Not to give away too much, but we are looking to make a small low power subwoofer that is inexpensive to make so that the cusotmer can buy and use two or three of them around the room. The problem is that we need the system to cover about 25 - 50 Hz. which is incompatible with "small" and "inexpensive". When I get this problem worked out, I'll let you know.But thanks for your interest. I am sure that someday we will see a high output lever used in Pro sound applications since this is the ideal application.