Subject: Subwoofer project update
Posted by Wayne Parham on Tue, 30 Mar 2004 11:18:31 GMT
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Regarding the subwoofer specifications discussed in the "Subwoofer project" thread:Eminence wrote to say that they have finished running magnetic FEA simulations and found that a flux stabilization ring can be added and electro-mechanical parameters be maintained as described in the thread above. But the way this was accomplished in their simulations was to add add steel to the core surrounding the cooling vent and reducing its ID. This was done in order to replace the steel that was removed to add the flux stabilization ring.I have asked that they consider other methods of increasing flux. Possibly using a larger magnet or use another alloy, perhaps a layer of neodymium. Decreasing vent size is an option, and it may be worth testing to see what the end result would be. It is possible that this is a non-issue, we'll see. But my gut feel is that I would prefer to address this by adding magnet instead of by adding steel and reducing vent size.

Subject: Re: Subwoofer project update
Posted by hulkss on Wed, 31 Mar 2004 01:08:44 GMT
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I don't see a problem with the smaller vent. It's quit generous in size as it is now. By the way, many of the LABsub cabinets are very close to the back of the driver and obstruct this vent to a significant degree. If you change the magnet size there may be fitment/mounting screw access problems.

Subject: Re: Subwoofer project update
Posted by Adrian Mack on Wed, 31 Mar 2004 08:26:04 GMT
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I wouldn't decrease vent size unless you want to increase power compression.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Wed, 31 Mar 2004 14:29:13 GMT
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Well, that's true. The vent is there to cool the motor, so making it smaller could potentially reduce power handling, increase compression and even increase non-linear distortion. The air that's trapped can be compressed further than it can be made a vacuum because you can't go less than zero atmospheres, but you can pressurize much more than two atmospheres. So vent restriction

could cause distortion to rise at high output levels.On the other hand, Eminence makes several long-throw woofers with a smaller vent. It is possible that there isn't a problem with the smaller vent. Certainly it isn't an issue until power is high, so as a high-fidelity woofer, the flux-stabilized version would perform better at reduced power levels even if the vent were smaller. And, as hulkss has pointed out, the LABhorn has breathing issues anyway, due to the fact that the cooling vent is restricted.Still, since the woofer is designed to be an all-out performance improvement, I tend to not want to cut any corners. I'd rather not decrease the vent size. There is another option that is being considered, and the only thing is that we'll have to wait a few more months. It's a no-compromise solution, so I think I'm leaning in that direction.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Wed, 31 Mar 2004 15:40:34 GMT
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I understand that the LABhorn places the motor cooling vent very near to the cabinet, and that this causes some airflow restriction. I've read numerous reports of this, and yet, since there haven't been a rash of failures, the vent seems to be keeping the motor cool. Vent obstruction may be increasing distortion at low frequencies, and so maybe we'll address this as a part of our efforts. But the point is that even though there are some reports of chuffing in the vent, I don't see a lot of overheating failures. Maybe the vent is oversized, or maybe it's just enough.We don't know what vent size is too small, so maybe it's worth building a sample to find out. But then again, we are sure that keeping the vent size large will allow the speaker to breathe better than a smaller one would. A larger vent will also help reduce chuffing, which becomes audible when excursion is high. I have been discussing these and other issues at length with people at Eminence.Jerry McNutt and John Sheerin have analyzed the problem and come to the conclusion that adding magnetic material wouldn't increase flux. The core is saturated, so the only way to increase flux is to add steel. So the existing motor configuration will need a smaller vent to include flux stabilization and meet required T/S specs.That leaves us with two options. One is to decrease vent size and use the existing motor layout with the addition of flux stabilization.The other option is to mount shorting rings in the plates, outside the voice coil. This option would allow the vent to be made larger, but is a major undertaking that would add a couple months development time.So let's cut to the chase. A flux stabilized subwoofer with required T/S specs and a 0.75" ID cooling vent can be made immediately. We would have evaluation units in April and if they met our expectations, we could be taking delivery on production runs in May or early June. Or we could wait for Eminence to tool-up for a version that puts the flux stabilization ring in the plates, allowing the cooling vent to be made larger. This would push back the dates, with evaluation speakers ready around the end of summer. If everything goes well, we'd be looking at late 2nd quarter 2004 for evaluation units and early 3rd quarter 2004 for production units to ship. That puts us into August or September.Since the woofer is designed to be an all-out performance improvement, I tend to not want to cut any corners. I'd rather not decrease the vent size. This subwoofer is intended as no-compromise solution, so I think I'm leaning in that direction. But I've told Jerry that I would let Eminence sit on this for a little while and think about it. I trust these guys, and I value their opinions. They've been successful at solving problems like these, and have the best engineering tools, magnetic FEA and measurement systems to pull it off. I'm confident they'll choose the best direction to go.I also want to get input from Chris Rose and Rob Gault on this

matter, because it's a pretty big undertaking. It's big both in technical scope and in production requirements. So I think it is prudent to let them think on this one a while before making any further comments. I'll report back in just a few days.

Subject: Re: Subwoofer project update
Posted by Adrian Mack on Wed, 31 Mar 2004 22:15:22 GMT
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G'day WayneI still reckon that a smaller vent is not a good idea, just as you say. What is the point in improving one thing, and then making another aspect worse than used in the woofer which needed "improvement"? (hmmm thats a nice catch phrase, I think)Just as an idea, if it will shorten production time, some manufactures vent underneath the cone instead. Here is a cutaway view of what Peerless does on their XLS woofers:A. Aluminum Spacer: The aluminum spacer serves as heat sink for the coil to reduce power compression.E. Vented Cone: To eliminate compression under the dust cap the cone is vented by 8 large holes. This way the coil is cooled and there is no need for a bore in the pole piece.If you look where the letter "B" is written, theres a gap there and the voice coil is actually exposed for extra cooling. It would mean you wouldn't have to redesign the whole motor layout, so you could get it out earlier. Maybe Eminence should do something like this?In Australia it's already end of Summer, when is it end of Summer in the US?Adrian

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Subject: Re: Subwoofer project update
Posted by Wayne Parham on Wed, 31 Mar 2004 22:32:13 GMT
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That's a pretty cool illustration!Eminence vents in front and back on the Kilomax Series, so I don't think they're opposed to that sort of thing. They also have radially spaced holes on them rather than a single large vent as other models do. But I think they're planning a central rear vent on the new motor. I don't know; They're still looking at it. Summer is pretty much June, July and August for we Americans. I'd love to spend spring and summer here, and then "fall" and "winter" there!

Subject: Re: Subwoofer project update
Posted by hulkss on Thu, 01 Apr 2004 00:30:46 GMT
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A .75" ID vent is plenty. The cone displacement will still pump the same volume of air. Actually, if the vent is too big, the air will mostly just go back and forth in the vent and not get pumped out and replaced with cooler air. If you look at the power spectrum of audio by far most of the energy on average is up at 60-80 Hz where the cone excursion in the horn at high power is only about

2mm.

Subject: Re: Subwoofer project update
Posted by hulkss on Thu, 01 Apr 2004 00:37:21 GMT
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In the LABsub the driver is basically a big highly loaded compression driver. I would not want to see any holes in the cone or dust cap to lower the strength/stiffness.

Subject: Re: Subwoofer project update
Posted by hulkss on Thu, 01 Apr 2004 00:45:27 GMT
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Tool up = Cost up = Price up.Chuffing sound may be an issue in a dipole bass speaker or in an application where the speaker is mounted backside out. Does Eminence believe that a .75" magnet vent could ever be audible or cause distortion in a closed back front horn cabinet?

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Thu, 01 Apr 2004 00:58:19 GMT
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You may be right about the vent size. But my concern would be with the possibility of air-compression non-linearity distortion at high excursions. What we gain from improving AC flux symmetry might be lost in pneumatic asymmetry. I could see how it might make pressures exceeding 2 atmospheres within the vent, and then since the opposite motion cannot go lower than 0 atmospheres, we'd have asymmetry around the 1 atmosphere centerline.That's all academic from my perspective though, a mental excercise, just for fun. I guess the real test would be to build the driver with a 0.75" vent and measure it to see. I'm confident that Eminence is able to assess the problem and come at it squarely. They've got the means and the research tools at their disposal to verify whether the port size is a problem or not, and if so, to provide a different solution.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Thu, 01 Apr 2004 01:00:25 GMT
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Well, that's a very good point, and again, you might be right. We certainly could get Eminence to build the units with 0.75" vents right away and test them. If they work well, it would defintely be a less expensive option.

Subject: Re: Subwoofer project update
Posted by hulkss on Thu, 01 Apr 2004 01:26:42 GMT
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2 atmospheres pressure? How is this possible? Even if I tape over the vent to seal it, the cone motion would have to reduce the trapped volume in half to get 2 atmospheres pressure. With the vent open, the sound pressure at the bottom of the vent needed to equal 2 atmospheres peak would be 194 dB!.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Thu, 01 Apr 2004 01:54:33 GMT
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You've got the idea, exactly. The volume in question would be what's behind the cap that's forced through the center pole. I haven't calculated any of the volumes involved because Eminence is working on it. But that's how the problem is caused, when compression exceeds the limits of pneumatic symmetry, which I believe is somewhere around 2 atmospheres. It's probably a little less, perhaps as low as 1.5 atmospheres.

Subject: Re: Subwoofer project update
Posted by hulkss on Thu, 01 Apr 2004 04:15:08 GMT
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I believe that there would be big problems long before the "limits of pneumatic symmetry" are reached.Full modulation of the atmosphere (plus and minus 1 atmosphere about a 1 atmosphere mean) is 194 dB. Just as a point of reference 50 pounds of TNT detonated 10 feet away will generate 200 dB (and kill you). Eardrums pop instantly at 190 dB. Your body will be physically damaged beginning at 150 dB.As I indicated before, I dont think any of this is close to happening in the LAB12 vent.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Thu, 01 Apr 2004 11:26:51 GMT
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I know the vent can be made too big, and reduce velocity to the point where airflow isn't good. My gut feeling is that would be a pretty large vent, and not really an issue here. But I'm wondering what size becomes too small, given the displacement of the piston which then translates to the swept volume of the pumped air.There's also the issue of vent and/or plenum resonance, causing a sort of ram-charge effect that increases pressure/vacuum cycles at resonance. But putting that aside for a moment, 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 experimental data on this subject? There must be some, 'cause compression non-linearity is discussed in other areas of engineering and science. I expect someone has done a pretty good study on it. Do you know where?It would be really good if your hunch that 0.75" was large enough at maximum pressure delta. I'll ask Jerry if Eminence has any means to measure pressure in the vent at various frequencies and excursions. That might provide some important information in this matter.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Thu, 01 Apr 2004 15:09:11 GMT
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Jerry says he plans to have the version of the woofer with the smaller vents ready for testing late next week. So it would appear this project is going very fast.It also looks like Tom Danley is taking delivery of a flux stabilized LAB12 next week. I think it is very likely that the same woofers we've been discussing here might be of interest to the folks at ServoDrive as well. Makes sense, so we'll see.
Danley says he will be taking delivery of flux stabilized subwoofer prototypes

Subject: Re: Subwoofer project update
Posted by hulkss on Fri, 02 Apr 2004 23:29:28 GMT
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This paper says the voice coil will cool the best if we seal the vent!
Nonlinear thermal modeling

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Fri, 02 Apr 2004 23:41:20 GMT

Klippel is definitely the authority on stuff like this. As you've suggested, there is range of vent velocities that are optimal. Let's hope the 0.75" vent is in the range. The version of the prototype MAG12 driver with the 0.75" vent will be done next week, so we should know how the real-world model performs very soon.

Subject: Reducing vent size
Posted by Adrian Mack on Sat, 03 Apr 2004 01:14:14 GMT

I do agree though that there comes a point when the vent can be too large so that theres no pump action and it is not drawing air in and out over the voice coil anymore. Obviously though the concern here is using a smaller vent size rather than bigger, 0.75". If it is too restricted it essentially creates a small acoustic chamber under the dustcap and beteen the pole piece, with constant compression and rarefaction of air pressure as the cone moves back and fourth. This would mean more heat on the voice coil, and also air-nonlinearity as you say which could be a barrier or restriction to the cones natural movement. I think this is why manufactures start adding additional air vents rather than simply increasing the size of a single air vent to reduce power compression. Is this possible to do on the MAG12? You could have additional air vents through the back plate which would be aligned with the voice coil or something, although this may also require a redo of the motor layout, just like the option of mounting the shorting ring's in the plates/outside of the VC (what was the plan before if we stick to the 0.75" vent? The shorting ring wasn't inside of the voice coil, was it? If so, I havn't see this sort of implementation used anywhere before, it's always been on the outside surrounding the VC on woofers that I've seen and in textbook diagrams or online). One thing for sure though is that power compression is bad, and I wouldn't want to play a juggling game with making an air vent smaller. Black anodized voice coils and extra heatsinks is an option to dissipate heat as well; unless some sort of other heat transfer device is implemented, I wouldn't want to see the air vent on the MAG12 reduced. Tom Danley commented on the live-audio forum his results from an experiment to examine power compression. He noted that typical VC woofers average -3db to -9db compression within the first 15 seconds, which also caused quite major resistance and frequency response changes, and T/S parameter shift. I wouldn't want to do anything which could potentially increase power compression and distortion, and the other non-linear affects that come along with it. I'm not sure if the original LAB12 woofer had any extra heatsinks in addition to the vented pole piece. My assumption though, is that this $150 woofer would have heat transfer or cooling similar to other woofers in its price range, which happens to be nothing special. What also pointed me toward that conclusion is because it uses a Kapton voice coil instead of a black anodized aluminium one, the latter being more effective in removing heat and has higher temperature characteristics. It just so happens that these woofers would have to have a lot more compression than your typical JBL pro woofer, which may have 4db or so compression at full power. I've seen on other websites such as Beyma and other brands, looking at their woofers which don't have all the high tech heat dissipation options like JBL, which DO actaully post power compression graphs which are some 6db compression or greater at full power on some woofers. Not to mention the increase in

distortion caused by this. That's why I assume the LAB12 woofer would be similar - by comparison, higher power compression just like these woofers. If this new MAG12 woofer is going to be as great as it's supposed to be, it must have adequate cooling. If the vent size in the pole piece must be decreased, then additional cooling or heat transfer methods should explored really. If you're worried about motor noise from chuffing in the motors air vent if its size is reduced, why not flare the air vent like is done in the lambda 001 motor. It's all just my opinion, but thats what I believe and what I would personally like to see happen. I dont even know how big the vent is in the LAB12 myself, the mere fact of reducing its size though, I would say that one cannot expect performance not to suffer. I guess we'll know just how much it will suffer after Eminence do the tests on it. Adrian

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Subject: But.....
Posted by Adrian Mack on Sat, 03 Apr 2004 01:19:48 GMT
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Perhaps the vent on the LAB12 is too big though, and decreasing the amount of air which can be drawn in and out over the voice coil. So in fact, reducing the vent size on the MAG12 could be a 'correction' to the LAB12's vent.I assume though that they didn't stuff up the vent on the LAB12 and that they considered it being larger to be better, and backed by some sort of experiments.

Subject: Re: Subwoofer project update
Posted by Tako Tamas on Sat, 03 Apr 2004 10:40:01 GMT
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Hi,Nice to see, you are all thinking a lot about the MAG12...I think I'v seen some speakers from eminence and of course from VOLT, that had heat sink in the front of the speakers. In the case of the LABhorn it means that the heat can be dissipated in the horn (free air) and not only in the closed box (back chamber). I think this could be a good improovement regarding cooling. If the speaker itself will have less distortion with the added stabilizing ring than the LAB12 while maintaining all the TS parameters and Mechanical dimensions like diameter, hole ring diameter, overall height, self Volume, etc and getting even cooler, this would be great!!!Regarding noise/distortion caused by the air vent's air flow and the very close aluminium cover, it would be nice to mage the vent opening more rounded maybe. But increasing the distance of the cover plate by 1-2 mm will help also.Thanks,Tako Tamas

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Subject: Re: But.....
Posted by Wayne Parham on Sat, 03 Apr 2004 15:27:20 GMT
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Yeah, could be. I've pondered the same sort of questions you have. Eminence uses Klippel measurement systems, as well as those from LMS, Clio and Audio Precision. They use Ansoft/Maxwell FEA for magnetic analysis of their motor structures. So they've got all the right engineering tools to really see what's going on. I'm hoping that the results are positive on the new structure, but if not, we'll just move on to the one with the rings in the plates. Either way, I'm excited to be involved in this project, and pleased that we'll have a good flux-stabilized subwoofer available soon.

Subject: Re: Subwoofer project update
Posted by Wayne Parham on Sat, 03 Apr 2004 15:40:13 GMT
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Eminence makes their Kilomax series with venting in the front and the back. The voice coil cover is a heat sink attached to the pole piece rather than a cap attached to the cone. The rear venting is done with several radially spaced holes rather than one large central port. However, the MAG12 is going to have a central rear port.A MAG12 prototype has already been made and will be tested next week. It is basically a LAB12 that's been machined to accept a shorting ring and steel added to the core to maintain flux levels. If it meets specs, we will be able to go into production immediately. If not, Eminence will make a second prototype that has the shorting ring in the plate, allowing for a larger cooling vent. However, this will take longer to develop and may cost more, so we're all hoping the first prototype performs well.
