Subject: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 08:59:53 GMT
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recent Prosound Shootout. Distortion is also incredibly low, due to the push-pull arrangement. A

hornsub was measured, but according to models, a pair should run 143dB maximum output at one meter and a group of 4 should provide 149dB, with flat response +/-2dB from 30Hz to 125Hz. Single horn response is very good, but it is improved even more in groups, with deepest 30Hz bass output lifted to the 100Hz level.See the chart below. Measurements were taken at 10 meters, so add 20dB to find the SPL at 1 meter. The blue line is is output with 65 volts input, roughly 1600 watts. In my recent tests of the heat exchanger, I found that the speaker can handle this level of contstant input power. Also notice the low distortion levels, which are shown by the violet line in the graph. Distortion is low across the entire range, but a particularly intersting

wattsThe distortion of most horns rises dramatically below cutoff, but that is not the case with the

sometimes sounds like a helicopter blade. What you hear are actually harmonics of the

distortion at low frequencies, and is completely dead quiet deep into cutoff below 20Hz. As frequency rises to the 30Hz level and above, output rises steadily. At that point, the bass was loud enough to vibrate the entire countryside, modulating voices to the point that conversation was impossible.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 09:21:37 GMT
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would be nice to invite others too, and make it a testing session. Kind of fun that way.I had already tested the heat exchanger on the woofers in free air, so I had a pretty good idea of what they would do. But while I had performed a destructive test on a woofer having no heat exchanger, I still hadn't seen a failure yet on a device with a heat exchanger. So there were two failure modes I wanted to see, to know the limits of the device. One was failure after extended periods, what I'm calling heat soak failure. The other was an instantaneous failure, one caused by extreme power levels provided to a relatively cool voice coil, one that hadn't been heat soaked.We had intended to run a 15 minute heat soak period at the Prosound Shootout, which isn't really enough to truly saturate the drivers, but would provide enough heating to see what changes in performance resulted. But we realized after the first battery of tests that we may not have time to do them. So we omited the heat soak test.Realizing that I could not heat soak, I decided to push

at 73.5v input (roughly 2000 watts), but failed at 80.5 volts input, approximately 2400 watts. From

2000 watts peak.Mechanical limits were never reached, with some extreme power sweeps starting at 10Hz. The driver did not sound strained at any power level, and it never reached a point of mechanical interference. The thermal limits were greatly increased using the heat exchanger, and distortion is reduced because of the push-pull configuration and horn loading. Distortion is incredibly low at safe power levels, and even at extreme over-limit power levels

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Rajeev on Sat, 15 Oct 2005 11:45:44 GMT
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Great Job WAYANE you have done it , CONGURATULATIONSRajeev

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Leland Crooks on Sat, 15 Oct 2005 11:46:33 GMT
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It was incredibly clean, and LOUD. Don't you think the prior tests up to 2400 would have provided heat sink enough. The heatsink plates weren't warming much, but if you touched the bolt it was hot. So they were doing their job.Are you going to post the rest on the prosound site? I don't want to steal any thunder by putting it on the Fitzmaurice site until you post it up. Leland

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 12:06:56 GMT
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I'm working on the rest of the data right now. I really thought I'd have it all compiled before anyone woke up, but I guess not. Give me another hour or two and I'll post photos and test data in the ProSpeakers forum, with a link to it on the Prosound Shootout website. Then we can all comment on what we learned as well.About the power levels, I wanted to see if I could reach a mechanical limit or if failure was always the result of thermal stress. I also want to find what the limits are in various conditions. So far, I have not been able to create a mechanical failure, they've all been thermal whether by heat soak or instantaneous burst.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 12:10:07 GMT
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expectations. It's big, but you don't need many of them. It's just an absolute brute.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Leland Crooks on Sat, 15 Oct 2005 12:21:49 GMT
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I work 6 days a week, always up early. That's what I get for owning my own business.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Walt on Sat, 15 Oct 2005 12:34:47 GMT
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Hello Wayne,Is the small dip at 40Hz also present at 1W input? If not that dip may indicate some sort of powerdip. My AJ-horn software shows this powerdip at the same place. But Tako has already shown that computermodels may be off.Nice to hear the 12pi did very well. Best regards,Walt

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 12:36:26 GMT
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I know whatcha mean. Every candle in the house is burned on both ends. Sure was good to meet you and hang out. I hope to see you again in May at the Great Plains Audiofest, and also at next year's Prosound Shootout.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Walt on Sat, 15 Oct 2005 12:46:36 GMT
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By the way I think the reducing of the frontchamber volume was very important for your design. Generally a too large frontchamer gives a non-flat response.I would like to see a graph which compares the 12pi to the Tuba 36. I think the 12pi should be 5-10dB louder in its operating range when driven at full powerBest regards,Walt

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 12:48:07 GMT
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The reason for the response ripple is the front chamber is larger than 20 liters. Front chamber volume is actually about 30 liters on this model. I'm happy with the response that provides, but it could be made smoother if the front chamber were reduced to 20 liters. I think you recall discussions about this between you and I in the past.I use fill to reduce the front chamber volume, and without fill, it's 40 liters. When the front chamber is 40 liters, response is similar to the LABhorn. It's fine that way, but by reducing the front chamber, the ripple is reduced. The magnet sets the limit of depth for the chamber, but volume reduction can be done by displacing some space in the front chamber using filler material or panels. It's pretty easy to get front chamber volume down to 30 liters, but going smaller than that requires more attention and difficult fill

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Walt on Sat, 15 Oct 2005 12:58:08 GMT
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Yes, I remember the discussions. I think we can be very happy with this result. Your original idea was to use a front chamber of 50 litres which would have caused a reasonably big dip. I think now the 12pi response is very nice.Still I would like to know if the dip around 40Hz is just as big as with 1W as with 1600W. If that is the case there is no limitation due to x-max in this 12pi design. Best regards,Walt

---

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sat, 15 Oct 2005 13:18:14 GMT
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The dip is present at the same amplitude at all power levels. I am compiling all the information

now to be placed on the website. Excursion isn't an issue - I even ran several sweeps starting at 10Hz at outrageous power levels and there was no mechanical interference at any power level. The limiting factor is thermal, not mechanical. The system runs into compression before suspension travel is exceeded. And failure is always due to thermal stress, which is why the heat exchanger is so important to this design.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Leland Crooks on Sat, 15 Oct 2005 14:26:38 GMT
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I'll be there. You got my audio jones riled up worse than it was. I have a plan

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Subject: Re: good one
Posted by Bill Martinelli on Sat, 15 Oct 2005 19:24:07 GMT
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nice job, glad it worked out well for you

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Shane on Sun, 16 Oct 2005 13:12:48 GMT
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Wayne, thanks for designing a pro-sub that those of us who can't necessarily get the marketed stuff can build and use. There were a lot of times when I was gigging in the "bar band" that our homebuilt subs just took a header because of design flaws and thermal breakdown. A couple of the 12 Pi's with a couple of 1000W amps sounds like it would work very well! When you're up and ready to put out the design, whether kit or assembled, I'll be sure and let all the struggling musicians I know find out about them.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Sun, 16 Oct 2005 13:18:43 GMT
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The design is completed so let everyone know. If they want the biggest and best, this is the one

to have. But it is very large, not really something I think most bar bands would be interested in. It's more for outdoor concerts and festivals, stuff like that.

Subject: Re: The Most Powerful Subwoofer in the World
Posted by Shane on Sun, 16 Oct 2005 18:55:43 GMT
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You would be surprised. We used to run two cabs that were about the size of the 12 Pi that had two 18" Widows in each cab. One cab was on the bass and one on the kick drum then EQ'd to just produce those nice low notes. It's not always about volume, but about the ability to produce the low end thump that makes the people in the front row want to pee. LOL!! We also played outdoors a lot in the summer time. If the soundman's doing his job it doesn't have to be ear splitting loud to get the job done.

Subject: Its a releif,
Posted by Mike.e on Mon, 17 Oct 2005 01:26:30 GMT
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Its a relief to hear a nice overall bass response rather than exagerrated midbass with nothing below 60hz!- I went to a dnb gig once,that used an obscure KVAUDIO system with multiple direct radiator 18"s in a 7ft x 40ft x 20ft room,and the SPL at ~45hz was insane-it was actually uncomfortable, and as loud as inside a car!Mike.e

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Walt on Mon, 17 Oct 2005 17:24:00 GMT
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I followed the 12pi horn from the beginning. I also did so with the LAB-horn. I never quite understood why there wasn't paid more attention to the 'dip' a single LAB-horn shows. To me it seemed a little more back chamber volume would offer a flatter response Although the 12pi frontchamber is still a little large the reponse for a single 12pi seems very usable. I think A/B testing with music has to be done to determine whether the push/pull arrangement pays off. But in theory it is a good thing so why not use it? Same with the heat exchanger but I have to agree with Tom that sine waves and music are a world apart. Also in a shootout on the Speakerplans forum the LAB-horn did very well on sines but there where cabinets that sounded more musical. As to the statement of 'most powerfull subwoofer in the world' that depends strongly on the frequency range. Here in holland 4x Punisher were way louder then 2x LAB-horn. Perhaps not the real sub range but things like shaking eyeballs and causing breathing problems they did very well. As for

power on these things, I know a guy who puts a single channel of a RAM BUX 5.0 on a 4-ohm Punisher, not bad for only a single 12" driver Best regards,Walt

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Subject: Re: The Most Powerful Subwoofer in the World
Posted by Wayne Parham on Mon, 17 Oct 2005 19:38:16 GMT
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I agree with you, 100%. I thought LABhorn response could have been a little better. The models certainly indicated that it could. So that's one of the things I focused on.Another thing that I focused on was really a sort of price / performance issue. I realize that DIY builders often discount labor costs and don't include it in the overall cost of ownership. But I always have, because I always have a cabinet shop build my speakers. So I design speakers with an understanding that cabinet cost includes labor. That drives my designs in certain directions.For me, a basshorn cabinet like this costs at least a thousand bucks. So it should be a no-compromise design to justify its cost. I could possibly make one that's a little smaller, maybe

than just throw an inexpensive woofer in the system, because the real cost is in the cabinet.That's where the push-pull idea comes in. I had considered using woofers with shorting rings, to take advantage of their reduced distortion. But I eventually decided to go with the push-pull idea instead. My thoughts were exactly the same as yours - If you have two woofers anyway, why not? It almost seems a waste not to take advantage of the arrangement. And it works, especially at the lowest frequencies.Below the flare frequency, all basshorns unload and cone motion rises. Every basshorn I've heard makes a chuffing sound down low, some sounding more like a beating. I'm not talking about the sound of mechanical interference, although some horns do that too, if xmech is exceeded. That's wht the Fitzmaurice guys called "farting" because it does sound that

just doesn't make that sound. Below horn cutoff, the speaker is just plain quiet. No harmonics. And then I realized that's what the "helicopter" sound is - It's when the harmonics are considerably louder than the fundamental from a basshorn driven below cutoff. The fundamental is almost inaudible, but the harmonics enter the horn and are amplified by it. So they can be something like

lowest bass notes aren't distorted. At the lowest frequencies, where the drivers are essentially acting as direct radiators, they at least have the push-pull mechanism to cancel harmonics and hold the distortion down. It works very well.And then there's the heat exchanger. I could write a whole chapter on that, but it's better just to click the link and see what's already been written about it. The thing is, no matter how you look at it, the device cools the motor. Whether its sine waves or music material, the issue is heat and the cooling plug wicks it out of the pole piece and removes it from the motor. If the music isn't driving the speaker to its thermal limits, fine. Then it isn't needed. But if the music has continuous low bass, then those subs are going to get a workout. That's when the heat exchanger becomes very important.Lots of people have written to me with LABsubs saying they're blowing woofers after every gig longer than a couple hours. My usual response is "I know". The most common failure mode of a loudspeaker is the voice coil coming loose from the former. It makes the speaker buzz or rub, the symptom everyone is familiar with. This is the result of continuous heat making the glue fail. It isn't from an instantaneous peak, which would fuse the coil or perhaps cause physical interference of some

sort, breaking the former, suspension or cone. It's from constant, steady heat in the pole piece and magnet, literally cooking the voice coil glue and causing it to fail.I was initially working on a fairly sophisticated air cooling device. My idea was to use a two-way valve, one side having laminar flow and the other with turbulent flow. This would allow me to have a hot air outlet and a cool air inlet. One of my best friends and partners is a brilliant mechanical engineer that specializes both in heat flow and fluid flow (gasses and liquids) and he helped me build the prototype. The prototype worked very well. But I realized something while working on it, and that is the air didn't carry much heat at all.It is important that the air surrounding the voice coil be cool, and that it be moving. Turbulence and airflow generally help remove heat. But the heat removed is actually pretty small compared with the volume of air. The interface is exceedingly poor, and not much heat is transferred. If there were fins on the voice coil or something, it would probably transfer more heat but that would hurt speaker performance in other ways. So there just isn't much surface area to work with and the best you can do is pass a lot of airflow by the coil and hope for the best. The air that passes by stays relatively cool, even if the metal inside is several hundred degrees.If the magnet gets hot in a small sealed cabinet, then the air gets hot too. That's bad. And more importantly, even if the air is cool like when the speaker is mounted on an open baffle in an air conditioned room, the voice coil radiates heat into the pole piece which is surrounded by ceramic. It's the perfect oven. And that's exactly what it acts like. The voice coil sits in a hellish environment which literally cooks the voice coil glue and causes it to fail. Just a few hundred watts is enough to melt the best glues, turn them black and brittle and allow the voice coil to come undone. That's why the heat exchanger is so important.If the speaker keeps moving and the air surrounding it is cool, then the venting action will help a great deal. But if the magnet temperature rises to 200º, cooling air won't help much. The voice coil will fail, because the glue can't take this kind of heat. So that's why I am so excited about the heat exchanger. It really raises the power limits on the driver. It does so removing the heat from the magnet and pole piece. These are what surround the voice coil, so we want to keep them as cool as possible.