Subject: Consider Using Tube Enclosures for your Speakers.....
Posted by Marlboro on Sat, 19 Sep 2009 16:42:38 GMT
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This is an unusual design. The speaker community is not into unusual designs, as a rule. They like boxes, even unusual boxes. They don't like cylinders and they especially don't like PVC tubes, and they don't like to be told that tubes made out of thin walled VERY LIGHT pvc, are better for all the reasons listed below than heavy boxes . Seven foot array speakers are supposed to weigh in at 500 pounds with all that MDF. Everyone knows that.

1. Unlike a box, as the pressure inside a cylinder increases, the walls of the tube become more rigid not less. As the pressure increases, the amount of flex of the tube itself actually get less. Its pure physics. So you can use thin wall PVC pipes, whose integrity actually gets stronger. With a tube such as PVC, there is no flexing and no having holes opening up in the sides of the enclosure. This also means the tubes don't tend to vibrate in the same way a flat wall does.

2. Standing waves are a huge problem with the muddying of sound from box speakers. Standing waves require parallel flat surfaces. In a cylinder, there aren't any except for the end cap(there are very small point to point parallel surfaces) . BUT THE END CAP IS OFTEN many inches away from the speaker through an awful lot of fiberglass. Additionally sound in tubes doesn't bounce back and forth against the walls, it travels down the tube. The physics of sounds in tubes is unusual. There is also a 3db loss per distance just like a near field

3. The resonance of air column of a closed cylinder is measurable, but generally its four times the length of the column. So the frequency of the resonance of the tube is usually related to the length of the column. Mine are 23 inches long. This comes out to a resonance of about 150 hz. My midranges cross generally at 165, so basic resonance is below the level of anything that the speaker puts out. But the tubes actually don't vibrate due to the rigidity of #1. And if they did, they would actually reinforce the low notes. And the vibration is minimal since each tube only carries 6.25% of the total mid range sound of the channel.

Another way you can do it is to arrange for the resonance to take place at about the lowest level that the speaker will be putting out: near the crossover. This will reinforce the bass. I have found this to be true and it does reinforce the bass at those frequencies. If I had made the tube length about 30 inches instead of 23, I could have obtained reinforcing resonance at about 100.

If the tubes were 56 inches long I would get a resonance at about 65 hz. However, the mid range speakers do need to go low enough without distortion to benefit from this. Mine don't go that low.

4. Fiberglass is the best sound absorber; Vance Dickenson had research to prove it . Sound doesn't really get absorbed, it gets converted to heat. Fiberglass is better at absorbing heat than the other kinds of insulation. Additionally, the degree to which the sound is absorbed by fiberglass is measured by the inches of insulation that the sound waves have to go through to reach the "end of the enclosure" before starting back. The attenuation is on the order of .90 per four inches(using 4 lb. per cu ft density.) Since my tubes are 23 inches to the back, not your normal 4-5 inches of a standard square or rectangular box enclosure, the attenuation of the absorption is better than 98%---a lot better. My tubes are 289 cu inches. There are 1728 cu inches in a cubic foot. This is 0.16 of a cu ft, of 4 lb. So the amount of fiberglass that needs to be

in each of my tubes is about 8 oz. I wrapped the fiberglass in polyfil batting to protect the speakers from stray strands of fiberglas, and due to the shape of the cylinder pushed the insulation in very tightly.

After much reading, I came to the conclusion that the biggest issue with midrange speakers is coloration of the sound caused by sound returning back through the speaker cone milli-seconds later than the directed output. The combination of high density fiberglass(but still allowing sound to travel through it, length of travel, etc, reduced the return sound coloration to less than 2% rather than the much higher number in non-long-tube enclosures.

And..... the coloration that does come through is only of the odd ordered harmonic variety(increasing clarity), and only comes from the speaker that emanated it in the first place, not 15 other speakers of varying speaker coloration in a giant gloppo of indifferentiated sound wash.

5. Tubes have the unusual characteristic of eliminating the even order harmonic energy because of the physics of sound in a closed cylinder. This means that half of the additional harmonic energy beyond the fundamental tones created by the speaker into the cabinet never appears at all. What is left is odd ordered harmonics, which at high distortion levels are not pleasant(but array speakers never get to distortion levels when the speakers are only carrying something like 6.25% of the total midrange sound). Additionally there is some research in electricity that gives a suggestion that odd ordered harmonic energy is more heat producing than even ordered harmonics. But the small amount of harmonics that do get back out the speaker in the front, if any, will actually increase the clarity of the speakers. I've noticed that too. My mid ranges actually seem to have greater clarity as they are pushed up in sound volume.

6. Using individual tubes for each of the midranges adds lots of complexity to the project, but the isolation of each speaker does wonders for the total clarity of the system.

7. Because it is a closed tube, you can actually calculate the exact resonance of the tube and also its harmonics(which of course are only the F3, f5, f7, etc. which is 50 60 db down from the fundamental.) A 23 inch tube has a fundamental of 145hz and F3 of 435,, and a F5 of 740. The fundamental will actually reinforce the upper bass of the small speaker, and actually allow a lower crossover to about 144 or so.

8. The whole speaker is much lighter. When you are talking about moving around a speaker that is 7 feet high by 8 inches wide by 23 inches deep, all that MDF might weigh 400 lbs. That's an awful lot of weight to be carrying around or pushing around for a man of my advanced age!