Subject: Re: Woofer cooling device - Destructive test - Ruminations
Posted by Wayne Parham on Thu, 25 Aug 2005 02:46:25 GMT
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The heat exchanger was originally intended as a improvement for basshorns where the rear chamber volume was very small. My thought was that probably the small chambers could easily superheat, and so the woofer motors inside might suffer from inadequate venting. But the more tests I performed, the more I realized that pretty much any loudspeaker used at power levels greater than about 100 watts could probably benefit from a heat exchanger like this.Certainly, the air in very small cabinets will heat more than larger ones. But even a free flowing vent (or preferably set of cooling vents on both sides of the gap) exposed to a free open area of cool air is only able to do so much. A lot of heat still saturates the magnet and metal surrounding the voice coil. As the power levels are increased, the amount of heat radiated is substantial. This makes a hellish environment for the voice coil, and the glue that binds the voice coil to the former can't take it.Think about how hot a 25 or 35 watt soldering iron gets. Or think about a light bulb. After you turn it on, the glass quickly becomes too hot to touch. 40 watt, 60 watt, 100 watt, they all get hot. Now think about surrounding the light bulb with 1/4" steel, and then surround that with a couple inches of ceramic. This really holds the heat inside. Sure, venting it and blowing some air back and forth helps, and it helps quite a bit. But the little box of steel and ceramic still holds a lot of heat, even when vented. That's pretty close to what a loudspeaker motor has to deal with, except that the wire that generates the heat is glued onto a coil former. It doesn't glow white hot, but it does get hot enough to radiate. And the power levels are often ten times that of a light bulb or a soldering iron.Think about how many speakers you've heard that were blown. Most buzz. When a speaker buzzes after high power use, it is usually because the voice coil has come unglued and part of the winding is whipping against the pole piece as it moves, or is dragging inside the gap. Those are very common symptoms of a blown speaker. After a while, the mechanical stresses on the wire bending and scraping will eventually cause it to open. But it may work for quite a while, buzzing, before the wire breaks. The cause is a failure of the glue that holds the voice coil on the former, due to excessive heat.If the rush of current were extremely high, it would fuse the wire and open immediately. It would cause an open circuit condition that happens very rapidly, almost instantly. Those kinds of failures do happen, but it has been my experience that they are rare. They are usually the result of a defective amp sending high voltage out on the speaker line, or some kind of accident that causes AC power or some other extreme over-voltage condition.Thermal failure creeps up on you. The speaker in danger of thermal failure is being pushed pretty hard, so it is defintely taxed. Its distortion and compression levels are obviously higher than if it were being used at lower levels. But it doesn't usually give any obvious indication that the voice coil is coming undone, it sounds reasonably normal. In prosound environments, the speaker may see most of its use at these levels, or just under. But the heat generated under these conditions is incredible, and it's always working on that voice coil glue. One day, push it a little too hard and the voice coil rubs.Of all the blown speakers I've run across, the vast majority have fit this description. They've had rubbing voice coils. So I think it is probably pretty important to do whatever is possible to get the heat out, especially on speakers used at levels more than 100 watts. I don't care if it's a horn, a box or an open baffle, it can't hurt to remove heat from the motor.So it occurs to me as I consider today's test that a heat exchanger would probably be good on just about everything. Basshorns and small sealed cabinets aren't the only ones that will benefit. They're just the obvious canidates. But even bass-reflex and open baffled speakers would benefit, if power levels are moderate to high.Even just a 8" to 10" disk fastened to the heat

tube will provide effective cooling. It doesn't have to be placed outside the cabinet either, although that will help. One could place a heat exchanger inside a cabinet, if it couldn't be easily installed to radiate outside. That won't get the heat out of the box, but it will get it out of the motor, where it's doing the most harm. Anything to get those temperatures down, and prevent voice coil glue failure.When the temperature inside the speaker magnet is cooking at 150º to 200º, the voice coil is even hotter. Temperature changes cause the voice coil to expand and contract, and when it's hottest, it expands the most, like a coil spring. That's also when the glue is the weakest, because it is being overheated. So it is really important to get the heat out, and I think it would be beneficial to use a heat exchanger like this in all high-power loudspeaker cabinets, not just basshorns with small sealed chambers.