Subject: Audio Note power transformer
Posted by Wayne Parham on Wed, 16 Apr 2008 20:14:01 GMT
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My Audio Note Kit 2 amp lost a power transformer this week. I spoke with Brian at AudioNoteKits.com and he said this is not unusual. Not that it's a high failure rate part or anything, it's a great amp, but still, this is the most usual suspect. The power transformers go out from time to time.What I'm wondering is whether there would be any downsides to having a transformer wound with slightly larger wire. Maybe Audio Note would do it, or maybe I could send the core to Heyboer and have them wind a custom part for me. Seems to me a power transformer is a pretty straightforward wind, and there wouldn't be any special considerations.

Subject: Re: Audio Note power transformer
Posted by Thermionic on Tue, 22 Apr 2008 06:40:25 GMT
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Hi Wayne,If you were told that it's relatively uncommon for this particular transformer to fail, the slightly lower copper losses of larger secondary wire most likely won't save you enough heat gain to make any difference. That is, if it would even fit in the existing winding window.The trafo probably has something like M19 laminations, which has significant core loss and runs hot, even if moderately loaded. It might be best to send it to Heyboer, and have them build you a similar trafo with M6 lams to ensure long-term reliability.Thermionic

Subject: Re: Audio Note power transformer
Posted by Wayne Parham on Tue, 22 Apr 2008 18:18:45 GMT
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Thanks for the advice. Let me see if I understand what you are saying: Changing core lamination material makes more difference than minor conductor size changes because of magnetic loss. Better to use M6 material than M19, either replace the laminations or build a new transformer with M6 core. Is that what you're saying?

Subject: Re: Audio Note power transformer
Posted by Thermionic on Mon, 28 Apr 2008 10:11:36 GMT
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Hi Wayne,Sorry for taking so long to respond! I've been so busy lately I haven't spent very much

time online.All other things remaining constant, just going from M19 to M6 will make for a significantly cooler running trafo than using the next gauge larger wire on the high voltage secondary. In many cases, you simply can't fit the correct number of turns of larger diameter wire into the window anyway. Transformer builders have detailed charts that tell them how much core they need to carry a given volt-amp rating, as well as charts that tell them which size wire to use for the application. Many builders use M19 when possible to save the customer some money. In some cases, however, it may be borderline iffy as to whether or not M19 will work in a certain application, and there's only one way to find out for sure. If it gets too hot when bench-tested under full load, they pull it apart and restack it with M6. Problem solved, provided everything else was designed correctly. Your Kit 2 has quite a high secondary voltage and draws a good bit of current as well, plus a significant power tube filament current draw. And, it has two separate filament windings. All that adds up to a WHOLE lotta wire, and I'd guess from looking at the size of the power iron that it's probably stuffed to the gills already. Actually, it may already have M6 lams, in which case you're just kinda stuck. You of course can't have a trafo built on a thicker stack, or go up to the next lamination size, because it wouldn't fit your existing mounting holes. IMHO, your best bet would be to get a Hammond 166N6 filament transformer (under $20) to run your power tube heaters from. The 166N6 is fairly compact and wouldn't eat up a lot of real estate inside the chassis, and would take a big load off your power transformer. A very good example is a set of paralleled SV83 monoblocks I just finished, using the same power transformer I use on some of my EL84 integrated amplifiers. The high voltage secondary and rectifier filament windings see precisely the same current draw in either amplifier. The only difference was that in the monoblocks, I used a regulated DC filament supply operated from a separate transformer, because they were to be used on 104dB efficient speakers and had to be silent at all costs.The transformer runs fairly hot in the EL84 integrated amplifier, where it also powers the filaments for two EL84s and a 6922. You can put your hand on it and keep it there, but it's quite uncomfortable to do so for more than a few seconds. In the monoblocks, the same power trafo runs nowhere even near hot. It barely even gets warm at all! This demonstrates the core loss/heat gain thing very clearly, as the DCR of a typical 6.3V @ 3A or 4A secondary might only be a couple tenths of an ohm. In your Kit 2, the I^2R heat gain would only be $3.2^2 \times .2 = 2.05$ watts of heat. Only 2 watts of DCR heat production is saved by moving the 6550 heaters to another trafo, but a lot of core loss heat production would be saved.Thermionic

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Subject: Re: Audio Note power transformer
Posted by Wayne Parham on Mon, 28 Apr 2008 17:10:14 GMT
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That makes a lot of sense. Thanks for the advice.I've noticed a similar phenomenon in loudspeakers when used at very high power levels. A significant amount of heat is generated within the core from magnetic loss, adding to the heat transferred from the coil by radiation. The biggest thing we all watch out for is voice coil heat, and the most popular cooling method is convection using vents. But we often overlook center pole heating caused by radiation and magnetic loss, which sometimes makes the core reach temperatures in excess of 200°F.Inside a speaker run at high power levels, the core temperature gets hot enough to cook with. It's surrounded by the magnet, forming a sort of thermos bottle that is very effective at holding the heat in. Over time, it bakes the voice coil adhesive and eventually causes it to break down, the

coil unwinds and the speaker fails. This is the most common cause of speaker failure, far more more common than voice coil fusing.This is exactly the same thing you're saying happens inside transformers. Makes sense.

Subject: Update: Audio Note power transformer
Posted by Wayne Parham on Thu, 31 Jul 2008 22:55:30 GMT
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It has been approximately 4 months since I replaced the power supply transformer in my Audio Note Kit 2. So far, so good. I listen to it approximately 4 hours every day and the transformer has lasted just fine. It gets really hot, but it's hangin' in there.I've been concerned about this amp though, because it regularly blows fuses. Not every day, but maybe once a month. Not enough to say there's a problem for sure, but after a couple times, it's worth looking into. I had time this week to open it up and check everything out, and sure enough, I found a problem that may be the cause of the blown fuses. In fact, in hindsight, I'll bet it's what caused the transformer to fail in the first place. Time will tell.By the way, I wrote Brian Cherry about this when it happened. He sold me the PS transformer replacement, shipped it quickly, and has provided excellent support. When the fuse blew after that the first time, he told me to check the fuse size, and gave some thoughts about primary and secondary windings, stuff like that. I mean, what can you really do to troubleshoot an amplifier problem over the phone? You really have to get out the scope or meter and check stuff out, without that, it's all just guesswork. But Brian was as helpful as you can be in a situation like this, more willing to help than I think most companies are. Great guy.So anyway, last weekend I opened the amp and checked some voltages. Found a problem right away - the left channel output tube was biased harder into conduction than the right side, about twice as high. So I retired the amp for a few days until I had time to look into it further. Last night, I had time to fix the amp. A coupling capacitor had become weak and was passing DC, so I swapped it (and all the other coupling caps) with new ones. Now, the bias levels are all correct, so I'll bet the fuse stops blowing every month.
Paper-in-oil capacitors

Subject: Re: Update: Audio Note power transformer
Posted by Frihed89 on Tue, 01 Jun 2010 08:50:45 GMT
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I see you traced this problem back to a resistor. I would add that the new AN copper foil caps make very good coupling caps in a wide range of equipment, but are pricey, although not like the Vcaps or AN silver foils. The new AN caps are no longer made by Jensen. However, Jensens new caps no longer leak and specs appear tighter. If you order AN caps, try and get them matched.

Subject: Re: Update: Audio Note power transformer
Posted by Wayne Parham on Tue, 01 Jun 2010 15:12:33 GMT
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The problem was actually a little more complicated than that, or maybe I should say the symptoms and cause/effect analysis were a little more complicated. I believe, in the end, the problem and its solution were relatively simple.

First, I should start by saying I am happy with my Audio Note Kit 2. It is used daily for several hours each day. Being a SET amp, a lot of heat is generated and these things are pretty reliable, all-in-all. I've owned the amplifier for several years, so it has been used for literally thousands of hours.

Over this span, I've had three major parts failures other than tubes or fuses. First was the power transformer failure, subject of this thread. The amp worked fine for a while after replacing that. Next, I became frustrated by repeated blown fuses, so I measured voltages in the circuit and found excessive quiescent current in the output stage. This caused the cathode resistors to get very hot, so hot, in fact, that the solder would melt.

I noticed the coupling capacitors on the inputs to the power tubes were leaky (both physically and electrically) and allowed DC to pass, unbalancing the tube bias and causing excessive quiescent current. The bad coupling caps were Audio Notes, by the way. After fixing that, I thought all my problems were solved. But the fuses kept blowing every few months, and occasionally the cathode resistors would still get very hot. So I eventually decided to fuse the cathode path. Now, the cathode fuses will blow every few months, but at least I'm not chewing up any other parts. Seems a worthwhile mod.
Fused cathode mod for Audio Note Kit 2

Subject: Re: Audio Note power transformer
Posted by SteveBrown on Tue, 01 Jun 2010 20:30:26 GMT
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Wayne, I can't imagine it going out like that.
I'd agree with your idea of having one custom wound and rated higher than the original. Of course, you could run into issues with it fitting the orignial space, but maybe that can be worked with.

Subject: Re: Audio Note power transformer
Posted by Wayne Parham on Tue, 01 Jun 2010 21:32:13 GMT
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Yeah, that was my first thought too, a couple years ago when it first happened. I'm still not opposed to that, but I have found that the output tubes shift after a while and increase quiescent current. They still work, but shift up the load line. If you open it up and put a meter on it, you can see the voltage shifts.

I suppose I could put in pots to allow variable bias, adjusting as each tube ages and its characteristics drift. But instead, I've just installed cathode fuses and when one pops, I know the corresponding tube has shifted.

It also seems like 6550's drift more than KT88's. A 6550 will start to draw excessive current before it dies but a KT88 just goes out.

Have you had these kinds of experiences with 6550/KT88 tubes or something different? Do you think it might be something unique to the Audio Note Kit 2?

Subject: Re: Audio Note power transformer
Posted by Frihed89 on Sat, 05 Jun 2010 18:01:51 GMT
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It's possible. The old AN caps were made by Jensen and had leakage problems. The new AN copper foil caps are no longer made by Jensen. And even Jensen has discontinued the old production model. Their factory is not too far away, but I still prefer AN.

Subject: Re: Audio Note power transformer
Posted by Thermionic on Sun, 06 Jun 2010 04:29:16 GMT
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I've used dozens of those old-model Jensen/Audio Note PIO caps, and have been fortunate that (to my knowledge) not one has ever failed in service. Of course, I observe some extra precautions when using PIO caps. I avoid using them where very high internal chassis temperatures are present. I also use carbon composition grid stopper resistors with them, as the composition media is a poor conductor of heat, and helps isolate them from heat conducted from the power tube socket.

Many PIO caps have poor thermal stability; when cold their DC resistance may be hundreds of megohms, but it plummets as they become hot. I once saw a Chinese-made PIO totally lose it just a few minutes after turning the amp on, due to heat conducted into it through its leads. You could see the results of the DC leakage as it increased; the power tube began to glow in a tiny spot or two, and then eventually hotplated all over. I replaced it with a Jensen, and about 5 years of daily use later, the amp is still doing well.

Thermionic

Subject: Re: Audio Note power transformer
Posted by Wayne Parham on Sun, 06 Jun 2010 14:05:08 GMT

The capacitors that failed in my amp were the new production Audio Note caps. Not to take away any of the good information on the Jensens or on paper in oil caps in general. Just wanted to clarify.