Subject: Cryogenically treated audio components
Posted by Wayne Parham on Tue, 22 Mar 2005 18:30:26 GMT
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Does it do anything? Might it actually harm components? If it offers poential benefits, what are they and why are they caused?I can understand it in materials manufacturing, sort of like tempering steel or making a hypereutectic structure. I can see how ultra low temperatures affect crystal growth during formation. I've seen papers about the correlation of properties of elastic porous microcracked conductors. And I understand the use of ultra-cool temperatures for certain materials to change their characteristics, like making a gas into a liquid or giving some meterials unique properties, like amorphous metals or superconductors. So these kinds of ideas aren't foreign to me, but I am completely at a loss about cryogenic treatments for audio conductors and components.What performance improvements can be expected?

Subject: Re: Cryogenically treated audio components
Posted by guitarplayer on Tue, 22 Mar 2005 23:36:04 GMT
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Disclaimer--I am in the business of cryo-treating and selling cryo-treated parts.First, let me comment on what deep cryogenic treatment is...and is not. Using dry ice or sticking parts in the freezer does not qualify as deep cryogenic treatment (DCT). DCT is the name given to the process of very slowly cooling an object down via the use of a cryogen (LN2 being the most common) to a temperature below -180C (-320F), holding the object at that temperature for a number of hours, and then very slowly allowing the object to return to ambient temperature. DCT generally takes place in a chamber of some type and is controlled entirely by computer. At these extreme temperatures, the atomic bonds start to weaken and the grain structure of metal becomes better aligned, more uniform and packed more tightly together. Metals, when drawn, or bent, or annealed, or whatever, develop stresses. These stresses are relieved by DCT. The reduction of residual stresses is why DCT is widely accepted in the tooling industry as it makes mills, or blades, or whatever, last much longer as the austenite (large particles of carbon carbide) is converted to maternsite (fine grained metal lattice structure).Tool steels really don't have alot to do with high performance audio, but the relieving of residual stresses and improving dimensional stability has many benefits for our beloved hobby. Close grain lattice structure in copper, for example, results in a smoother more detailed sound as the signal encounters less resistance (although this cannot be measured) flowing on down the road. Many of the metals employed in the manufacture of cables, PCB's, power cord ends, connectors, etc, benefit greatly from DCT. DCT has also been shown to improve the strength of plastics, so greater durability can be expected as well. However, DCT is not a cure all. It does, in my experience, improve almost everything, but some caution is required as different parts require different treatment profiles. In treating whole pieces of audio gear extreme caution is required, as is finding a treatment house that has experience treating stereo components. Front panels can break and electrolytic caps can be rendered useless if a proper profile is not employed. Properly preparing the equipment for DCT is also vital. Performance benefits are many. IMHO, the sound becomes much smoother, while becoming more detailed. The music emerges from a blacker background and dynamics are also improved. I know, I know, it sounds like I am crazy, but try it, you'll like it.Regards,LeePS--I look forward to meeting many of you at the GPAF!

Subject: Re: Cryogenically treated audio components
Posted by Wayne Parham on Tue, 22 Mar 2005 23:49:09 GMT
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Let me be a devil's advocate, or in this case, a devil's critic. This will help clear the air some, I think.Most components are rated for use at a specific temperature range, and for storage in a certain range too. Parts made to handle greater range for the military (MIL SPEC) have wider temperature range, and so are used in places where extreme temperatures are expected, like aerospace and things like that. They are able to handle lower temperatures both in use and during storage. But my point is that aren't these temperature ranges exceeded with cryogenic treatment? Don't certain materials become brittle? And like you said about the electrolyte in capacitors, doesn't that cause problems too? Are there some things that cannot be treated?

Subject: Re: Cryogenically treated audio components
Posted by guitarplayer on Wed, 23 Mar 2005 00:24:57 GMT
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No, nothing becomes brittle. This was a problem way back when DCT was being developed. The problem was the cool down of the object subjected to the cryogen was happening way too quickly. We all probably remember the experiments we did in HS with LN2 where one would stick a rose in LN2 and then you could shatter it. That is why the temp. must be brought down very gradually, or damage could easily occur. Brittleness was an issue with "thermal shock", a by-product of not being able to control the rate at which things cooled down. Being as we are in the age of the computer (and really cool solenoid controlled valves), this is simply not an issue anymore if proper procedures are followed.I haven't found anything yet that cannot be treated, but I'm sure I will someday. Pantyhose last longer, razors last longer, golf balls fly farther, etc...I will bring some Bic razors (that have been DCT) to the GPAF for members here. You'll have to ask for them so I know who you are, but you will be amazed at how long they last. Perhaps someone could write a review on the fine quality shave they received! Regards, Lee

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Subject: Re: Cryogenically treated audio components
Posted by Wayne Parham on Wed, 23 Mar 2005 19:09:07 GMT
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Have you ever cryo'd a vacuum tube and then compared it for differences? If so, what did you find? Same questions for bipolar transistors and FETs.

Subject: Re: Cryogenically treated audio components
Posted by guitarplayer on Thu, 24 Mar 2005 11:56:51 GMT
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I have done tubes, makes a very nice difference in retrieval of inner detail and smoothness.I havent done trans. by themselves and compared the differences, I have experimented with whole stuffed PCB's and cryo made a positive difference on those.My son is building a gain clone, I think I'll have him build 2, 1 cryo'd and one not and compare the differences, I post results here in a month or so.Regards, Lee

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Subject: Re: Cryogenically treated audio components
Posted by Wayne Parham on Thu, 24 Mar 2005 17:19:49 GMT
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Sounds interesting. I'm anxious to see and hear what you have at GPAF.Your proposal is a good experiment - Buy two LM1875 or LM3875 chips and cryo one of them. Use them each with identical power supplies, source and speakers and that way you can demonstrate the cryogenic effect! That would be super to see at GPAF!

Subject: Re: Cryogenically treated audio components
Posted by wunhuanglo on Fri, 25 Mar 2005 00:21:42 GMT
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It seems every claim concerning discernable effects results from treating ferrous alloys – which is probably due to the well know austenite/martensite transformation.But it really is quite unclear why there’s any benefit to BCC structured materials – in fact guitarplayer claims that it improves the conductivity of Cu, but then says the change is unmeasurable. If you can’t measure it, how do you know it happened?Though cold soaks will relieve stresses in castings of BCC materials by inducing localized cold-work, I don’t see why a simple anneal cycle wouldn’t provide the same benefits in conductors at a fraction of the cost.And again, since there’s no measurable difference in conductivity between annealed and cold-worked Cu, why bother with either?

Subject: Re: Cryogenically treated audio components
Posted by guitarplayer on Fri, 25 Mar 2005 02:22:13 GMT
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Sound quality! Clearly stated, IMHO, I hear a positive difference when a component has been DCT.If measurements are the only yardstick we use to determine sound quality, why listen to tube equipment? In fact, why bother with high performance audio at all? I have a 10 year Denon receiver in my garage that measures impeccably, but...Measurements don't tell the whole story. Our hearing is still the best measurement tool we have. Over the past 25+ years I have been involved in this crazy hobby, I have seen so many "treatments" or "proprietary deisgns" that, like you, I am skeptical of most of the strange tweaks that come along. In fact, I felt, a very short time ago, that cryo was a bunch of baloney...until I sat down and listened to the difference it can make. Now, not only do I own the Hair Club For Men...no wait that's something else entirely. In any event, I'll make an offer to anyone on this board. I made up two identically constructed power cords, on cryo'd, one not. I'll send them along to anyone who wants to compare them as long as they will pick up the shipping to the next person. Let me know if you are interested and I'll make a list and send the PC's out to the first person as soon as the cables are back from their world tour of Audio Circle.If you hear a difference, or don't hear a difference, post the results here. Should make for some interesting duscussions.So far, this board is a ton of fun! Lots of knowledge and pleasant people here. I look forward to meeting some of you at the GPAF.Regards, Lee

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Subject: Re:thank you for your offer
Posted by wunhuanglo on Fri, 25 Mar 2005 10:16:30 GMT
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Maybe somebody else will take you up on it. Myself, I'm firmly in the objectivist camp.One point of reference I do have vis-a-vis performance of electronics after exposure to LN2 temperatures is a program I worked on for a couple of years.We built a series of electro-mechanical devices - very high precision optical encoders that incorporated digital and analog circuits mounted to 7-layer PCBs. The application was sub-synchronous altitude satellites, so we weren't fooling around here.The electrical and mechanical performance was extensively characterized before we went cold for about two weeks on each device. What I remember is that there was no change in how the electronics performed, before or after return to RT. Our issues were with the delta-alpha problems between the steel bearings, the quartz optical elements and the beryllium structure, but the electronics were completely stable as far as anyone could measure.The stability of the electronics was a key issue because we were measuring 1 part in 2^24 (+/- 20 millionths) of a single rotation of the devices, and they had to be repositionable to that accuracy after many rotations. The point is that if the electronics drifted at all you couldn't get back to your original position – but we always did, as measured by a laser positioning system (LUPI) external to the devices.So at the bottom line, there was no effect on the digital / analog electronics after exposure to LN2 that could be discerned by a bunch of USDA-certified Rocket Scientists.   That may be not enough of an experiment to indicate what might happen to a power cord, but it's good enough for me.

Subject: Ping guitarplayer
Posted by colinhester on Tue, 29 Mar 2005 03:06:17 GMT
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Please send me your email address and real name to colinhester (at) yahoo (dot) com. I have a proposal regarding cryo'd cables.....Colin

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Subject: Done (nt)
Posted by guitarplayer on Tue, 29 Mar 2005 11:31:01 GMT
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Subject: Re:thank you for your offer
Posted by mpeg2 on Fri, 31 Mar 2006 15:43:13 GMT
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Although I now work in the Digital Television field, my background is in materials engineering. I've been following some of these discussions of cryogenically treating components with a sense of amusement - especially, since I've yet to see any discussion by anyone that understands the temperature effect of transformations in metals and semiconductors. If one examines phase diagrams for many of the materials and alloys being discussed, they will quickly note that the phase transitions all take place at elevated temperatures - there are none in the cyrogenic region. This means that there will be no change in crystalline structure of the materials upon cooling to LN2 temps. Other affects - such as removing imperfections (dislocations, point defects) are very temperature sensitive. The kinetics basically say that at these temperatures the defects will be frozen in place - not removed as is being suggested.There are noticeable effects of low temperatures on many materials (for example, the classic liberty ship cracking - or the samauri sword issues in mainland China during winter) - but these are due to a ductile/brittle transition in ferrous metals - impeding dislocation movement. Mechanical properties under stress are affected - not electrical properties that remain after return to room temperature.The notion that the atomic bonds weaken at low temperatures is actually backwards. Annealing of defects will take place at high temps, not low (just look at the kinetics). A good example of this is the quenching process for many materials. High temperature treatment can induce mucleation of new grains. If the material is cooled slowly, then the grains can grow, leading to a softer material. If it is instead quenched at a high cooling rate, then the fine grained structure is frozen in place. Increases in the rate of cooling and decreases in the final temperature increase the fineness of the structure. This is the opposite of what is often claimed.From a materials engineering viewpoint, I'd find it highly suspect that there'd be any changes in tube materials, copper or especially semiconductors from a cryogenic treatment.   Rich

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