A.8 … and the Ultimate End: Cryo-Schlock

It may have been sometime around 1990. I was already somewhat known as an acoustician and in the mail was a parcel containing a "sound improver" for me to test. I've since forgotten its designation: let's just call it "Schlock". The letter accompanying the parcel revealed that I was holding in my hands a miracle retailing at 350 Deutschmarks (DM). It was suggested that I please dignify it properly, and - if at all possible - recommend it to others. We scientists are not generally adverse to anything new, so I analyzed it more closely. It looked like a plastic clothespin with a naked semiconductor chip (called a 'die' in the trade) mounted to it. And that was it: a 'die', not connected anywhere to anything.

Since such a clothespin cost 15 German pennies at the time, the 'die' obviously had to be quite a terrific thingy; a lot of MIPS crossed my mind … or even MFLOPS? We had just bought some outrageously expensive Motorola 56001 prototypes – at a grand apiece, and so those 350 Deutschmarks didn't really scare us much. Still: while we could not peek into the interior of the Motorola ICs, all my co-workers had a sure sense that most ICs would somehow have to be contacted somewhere. "Bonded", my hardware engineer told me. However, that "die" sat there on the Schlock - no contacts whatsoever. Anyway, I first read what it was all about: *"Clip the Schlock across the speaker cable – then play your music – wait for the Schlock to calibrated itself ... and you'll notice an extraordinary improvement in sound."* Any Doubts? The scientific justification was included: *"We all know from our physics course that a magnetic field is created around each* wire". Well … yeah – assuming that a current flows through that wire. *"Magnetic fields generate electrical voltages in wire turns."* Okay, now I understood. Although … wire turns?? OK, there would be some conductor loop somewhere in the chip so that the law of induction could generate its euphorigenic effect. *"Physics also teaches that the effect of the magnetic field is bilateral: the chip reacts back onto the speaker cable."* I'll be damned! Why didn't I come up with that myself? Of course - this was a super-DSP that autonomously detects and corrects the deficiencies of the speaker system. Y'all know: that ain't easy – we indeed should give the thing some time to tune itself to the system. Round about 20 minutes, the enclosed instructions explained, and then everything would be set. If not: you may want to clip the Schlock to another section of the cable, and wait … (repeat ad lib) … and after a few iterations, you'll then have found the sweet spot, for sure.

For a moment I wondered whether the sender of the parcel saw me still living in a mono-world because he had sent me just *one single* Schlock. But again, the instructions had some good advice: for standard stereo systems you buy two, and for your quadraphonic setup, you buy four of the guys. Four Schlocks – that would've set you back 1400 DM. (Special note to my fellow German senior citizens: please do not simply divide that number by two. The loss of purchasing power brings the price up to roughly 1,400 Euros today, subject to favorable development in certain countries run by EU partisans. *Why is the semantics checker sending me a warning now?* Uh-oh – sorry, I should have said *EU participants*.) But back to the Schlock: Now the system sounds perfect? Wait, there's more! Because there's current not only flowing down the speaker cable, there's also the power cord! It benefits from a Schlock, as well, and of course all interconnecting cables. The antenna cable was not explicitly mentioned in the instructions, but well-established physics teach that inside ... that's right: electric currents do flow. Um … could we ask for a discount if we buy a full complement of 8 of the Schlocks?

This episode ain't made up, I actually had the thing on my desk. It was gray … can't remember much more. Sent it back – didn't want to spend any money on it. A Schlock on the cable? Total nonsense, technically speaking. A psychologist would arrive at quite a different assessment, though, for an auditory event is something entirely different than a sound event.

Why does one person just loooove Justin Bieber, but the next person doesn't so much? And why might those who find him *super*-hot today, may only look away in sheer embarrassment in 5 years time? Why do some Stradivarius violins sound less than special when rated in a blind test? Because the human being is a most subjective measuring device - enthusiasm will shift the given scale pronto (You married? Brazilian? 25 years old, prospective doctor? ☺ ☺).

What we hear depends on the sound – no question there. But it also depends on our subjective judgment, which in turn depends on our experience - and on our current mood. That's where advertising comes in: if we only believe that this super-cable sounds special, it will sound very special to us - and we will buy it. Anyone who believes in the Schlock will actually hear a sound improvement. It's that simple. To assist the faith, some physics come in handy, as will a cool name (admittedly, "Schlock" would be suboptimal here), and an exorbitantly high price helps, as well. Because those who spend a 100 grand on a stereo won't be satisfied with a run-of-the-mill DIY-store cable. And if you can shell out merely 2 grand for the amplifier, you might (for your next birthday) let the dealer squeeze 400 Euros out of you for the cable - and consider yourself bit closer to the 100-grand-system. The genuine high-end customer will, however, only turn away in disgust – 'cause his speaker cable costs more than 10,000 Euros. Yep! Witnessed by some trustworthy people in a Munich specialty store: Over € 10,000 – per channel! By contrast, the *"Infinite Fidelity Speaker Cable Reference-XXL"* offered in the electronics shop round the corner is kinda too cheap at € 6.90. Oh shit, that's just shipping … the 3m braided *Infinite Fidelity* cost 6400 Euro. Is it even possible that they could slap on any markup given that price dumping? How about we let an expert speak [www.highend-anlage.de]:

Mornin'.
So, what I read makes me, a longtime hi-fi distributor, blush with shame. Those who in all seriousness want to assert that there is no difference between cables (materials, cross-section, shielding, etc.) should first learn to listen. I've been successfully doing hi-fi and high-end distribution for more than 14 years now, and I can say without exaggeration that with the cabeling, I can sound-wise take full advantage of a component chain, or I can ruin it.
On the topic DIY-store cable vs. speaker cable: physically proven and therefore indisputable is that a cable is a waveguide. Accordingly, 90% of the total electrical information happens on the outside of the cable strands. Electrician's cables and cheap LS-cables from the DIY store have a cross-section of 1.5 mm^2, and between 8 and 25 strands. An inexpensive hi-fi loudspeaker cable with the same cross-section (Oehlbach #1040, 1.5 mm^2 copper, for example) has 5 separate sub-assy's of stranding of 40 strands each, i.e. 200 individual strands! You don't have to be an engineer to calculate that with such a large surface maximization, considerably more signal and thus more information reaches the loudspeaker.
It is also a fact re. DIY-store cables that they are not pulled under a protective atmosphere, and thus the outer layer of the strands is oxidized throughout. Copper oxide has a much worse conductivity value compared to oxygen-free copper. Thus, the negative effect in the topic "DIY-store cable vs. hi-fi cables" further increases (fewer strands, and those few oxidized in addition).
Capacitive and inductive interactions cannot be denied, either. Every 1st-semester **student of electrical engineering** can calculate the capacitive effect of a loudspeaker cable (the LS cable is similar in cross section to a capacitor; capacitors are fundamental building blocks in each crossover for loudspeakers; thus the cable capacitance should DIRECTLY by connected to sound-altering characteristics). The ratio of the strengths of insulator and conductor thus plays just as large a role as the electrical properties of the insulating material. In their Rattlesnake series, for example, Oehlbach even inserts a dummy core made of insulating material centrally into the cable assy – in order to keep the capacity of the cable as **neutral** as possible. With a cable length of **3m**, a capacitance of **10 to 20 pF** can easily occur. Considering that capacitors that are used for crossovers are rejected at such a tolerance, one should really give some thought to whether the speaker sounds at home the same way as it does in the showroom, if one does not use a decent speaker cable.
It only remains to mention that hi-fi speaker cables are largely immune to self-induction of the strands, since the latter are **twisted** and thus shield each other. The cable from the DIY-store has a much simpler structure and is merely pulled straight into the insulation without twisting.
As regards the cable cross-section, the following can be said: a circuit is very often comparable to a water circuit. A multi-purpose, 10-cm-wide C-hose (used as a standard by the **fire department)** discharges will – with the same water pressure made available by your local water provider – shoot many times the amount of water that will trickle from of the Gardena garden hose when the neighbor is washing his car.

The fire department taps into the same water pressure as John, your next-door neighbor, the difference being that the FD crew have 10 times as wide a pressure line, and much shorter hose distances at their disposal (neighbor John has another 100m on the drum, while the boys from the brigade switch to the 15-cm-wide B-hose upwards of 20 m hose-length). Let's translate these empirical observations into physics: logically, the resistance of the cable increases proportionally to the length, just like the resistance of the water pipe. The electrical conductivity of the cable is defined by the reciprocal of the resistance (conductance = 1/resistance). As the resistance increases, the conductance decreases. That much for the mathematical logic. In order to obtain a constant optimum conductance value in the hi-fi area, experience has shown that the following rule of thumb can be applied: use 1 mm^2 cross-section per (started) 2 m cable length. As I said, this is not a law, but only an optimal guideline, and is more applicable for full-range operation, i.e. for stereo- and main-speakers. The surround-channels may be supplied up to 15-20m cable length via 2.5 mm^2, and will incur only very minimal perceptible losses, since much less power flows and also a completely different frequency spectrum is pushed through then, compared to the front channels.
All these fakes are just the tip of the iceberg. Anyone who still says that he would hear, in the face of irrefutable physical evidence, no difference between DIY-store-cables and hi-fi cables, should seriously consider whether the components on his hi-fi chain are a good match (I would happily be available for **advice**), or whether he wants to be messing around only with MP3s and pirated copies. Because THAT is not hearing/listening, and has nothing to do with hi-fi ! March 17, 2008, Norman

Doesn't that make for a nice point of attack: it's a guy from the sales department! He certainly has learned his lesson well, and brings on science and physics right away. Sure: *a cable is a waveguide* (as hollow as the sales dept., then?). But why is 90% of "the information" on the outside? That's not a fixed percentage – it's frequency dependent! And – begging your pardon, dear Norman – the outside of the waveguide is a lateral surface. It does take, however, a cross-sectional area to judge resistance. Anyway, Norman opines: at high frequencies, the electricity flows mainly in the outer layers, and he's right, in principle. With a 1.5 mm^2 cross-section, however, effects become noticeable only beyond 20 kHz – interesting perhaps to the hi-fi fetishist, but not for guitarists. The corollary is where it get's interesting: the *maximization of the surface*. 200 individual **strands**! Actually, these are termed not individual strands, but individual wires, but no matter. However, the wires would have to be individually enamel-lacquered, as is the case with the actual RF-strands, otherwise the surface enlargement just won't happen. And if they are indeed individually lacquered, then the wires also need to be individually stripped for contacting! Whether loudspeaker cables are produced under inert gas … we don't know that, and we'll leave it, for now. However: if the expensive high-end cable actually has individually lacquered wires, and if the cheap DIY-store-cable allegedly has (slightly less) single wires that oxidize on their outside (i.e. a thin insulating layer forms), then ... hmm ... well .... And then: when actually did we last encounter a cable that was heavily oxidized? Right, at grandma's, over 70 years old (the cable, not grandma!).

Now we turn to the **student of electrical engineering** ... and thus again to the physics. Capacitance – yes, absolutely correct. But what is **neutral capacitance**, then? The one that is supposedly is, at a length of 3 m, 10 - 20 pF? Or does Norman mean *neutral = 0 pF*, and *10 - 20 pF = rejects*? Both interpretations would in any case be real nonsense: a regular cable has 70 - 200 pF per meter). Moreover, capacitors used in crossovers have some umpteen µF, thus 10 - 20 pF would correspond a tolerance of about 0.0001% - this is 10,000 times better than the tolerance of good capacitors. Only total duds would reject a capacitor for such a tiny tolerance. The matter of twisting strands or wires, on the other hand, cannot be dismissed: while the cable inductance is not really bothersome at the relevant frequencies, nothing speaks against twisting. Next comes the fire department: allright, that's well-meant … large cross-section, OK. For 3 m cable length, a cross-section of 1.5 mm² is a decent fit – we have already seen entirely different, monster-ous numbers. And Norman even offers advice at the end - but hey, what can you do: he's a salesman. Right. So now let's now take a look at the numbers, it's 1st-semester electrical engineering stuff, after all. Two-wire or coax cable, copper or silver, Ohm, Henry, Farad, let us calculate, then.

A copper cable (2 x 1.5 mm^2) of a length of 3m has a series resistance of 71 mΩ (0.071 Ω). This is very little compared to an 8-Ω-speaker and does not even incur 1% power loss. And that's connected to a perfect voltage source! Tube amplifiers, however, rather are current sources. More specifically: With the AC-30, the source impedance that the speaker 'sees' increases, using this cable, from about 200 Ω to 200,071 Ω. Forget it. Skin **effect**? At 10 kHz, it increases the cable resistance by 6% - but at this frequency, the speaker impedance increases by over 300%, so again: forget it. Cable capacity? That will only start to play any role in the MHz-range, compared to those few loudspeaker-Ω's. Cable inductance? That's about 1 μH, and thus about 1000 times smaller than the speaker inductance. **Conclusion: it's all insignificant. Completely, utterly insignificant – just forget it.**

Anything else? Yes! One manufacturer has another argument up his sleeve: cables carrying a current will attract. **Forces** are at work here, and only a particularly robust cable can withstand these (namely the cable of that particular manufacturer). Forces, right! Referenced to the area and thus also referred to as pressure. Given your typical currents, that will amount to, by and large, 1 Pa (1 Pascal). Is that a lot? Yes and no, depending on the point of view – everyone has to decide for themselves. To give a guideline: the atmospheric pressure on our earth is 100000 Pa. The pressure (force) between two wires will be a 100000^{th} of that. Oh wow!

What have we learnt? Physics mumbo-jumbo, cool names, and ridiculous prices will always find their victims. If you want to connect a speaker, you don't really have to be trained in electrical engineering. It does help to blow the cover of dubious bullshitters, though. All the above physical effects are relevant for TV cables, but not for speaker cables. Forces are generally irrelevant, mechanical strength, shielding, and appearance may be important. APPEARANCE? Of course, that's the only justification for that 10-grand-cable. Who puts steel rims on a Testa Rossa? Exactly, there you go! Once you've graduated from Wall-Mart to Fender … as soon as you can play not Just in C-major but also in B-locrian, you really do need a professional cable. And a Schlock. It audibly improves intonation and timing!

Now, after that … there's one more height we can climb: "**cryo tuning**". We all know from physics (wicked, ain' it!?) that metals are of crystalline structure. Unfortunately, the Lord has not seen to it that these crystal structures are always perfect, they include dislocations and other lattice defects. However, if you cool it all down a lot, and heat it back up to room temperature, the crystal grid has sorted itself out. The metal is somehow jivin' with a cooler goove, if ya know what I mean. It's true! Even patented! Word! So plunge your cables, your jacks … what the heck: your whole guitar **and plectrum** into liquid nitrogen (or at least bring it close) … and Hendrix would've gone pale with envy had he heard you afterwards. Now, let's take a trip to the southern climes – Sicily, for example. Compared to the Norway-vacation, something catches our eye: "Jeez, these be wee folks here!" A tad more demographically: the average height of southern European residents is significantly smaller than that of northern Europeans (who are thus vertically less challenged). And another thing is striking: though the Sicilians often pursue an activity that does not reveal itself at first glance, they go to Catholic church every Sunday. In the North, however, Protestantism dominates. So what do we learn from this? *Catholicism causes dwarfism!* Not convinced? You think someone has confused correlation with causality? Never mind: in sales, that's neither here, nor there. If Cryo-Tuning helps butcher knives to be sharper, it also has to improve the guitar jack. We also get to learn how it works: the resistance is reduced, due to crystal lattice order. Cleaning up has never done any harm, not even in the crystal lattice. So: send in a jack for tuning, or buy a socket tuned that way (now at triple the price), install it, and ... yeah, what really? The pickup has e.g. 6000 ohms, the amplifier e.g. 1000000 ohms, and the socket sports a mere 0.009 ohms instead of 0.01 ohms. And is now referred to as a Cryo-jack.

We do not want to allege that cryo-treatment doesn't change anything. Let's believe the advertisement that *"the goal of any heat treatment is to turn as much austenite into martensite* as possible" [www.cryo-tuning.de][⊕]. That's about **carbon** steel, though, not Telecaster bodies – those ain't made of steel. And if that jack is indeed made of hardened steel, and – after the cryo-treatment – has become *"considerably more conductive" because of the now denser molecular structure* … that couldn't be any more immaterial. Really. It will so completely NOT matter. Not everyone believes this, however: *"The Cryo-treatment results in a denser molecular structure, and thus electrical components such as cables, pickups, pots are considerably more conductive"* [www.georgeforester.de]. Pots – aha! Does the 500-kΩ-potentiometer then only boast 400 kΩ after treatment? Would that really be what is desired? Or a cable dealer: *"What exactly does the cryo-treatment do? If materials are exposed to these extreme temperatures for a defined time-temperature span, a kind of pressure builds up in the material. During "relaxation", a change in the molecular structure occurs. The molecules align themselves more uniformly, bind more firmly, and form a much more stable structure. This considerably improves the electrical conductivity and thus the transmission of energy and signals. For example, copper or silver, or other electrical conductors and connectors, have a freer flow of electrons.* ***The sound enhancement is just enormous."*** Ouch! That really hurts: the freer flow of electrons in copper or silver? How the heck do people come up with such nonsense? Presumably via inferences of analogies. An example: a well-known author of a well-known magazine offers a workshop in which the **barbecuing** of a guitar is celebrated. A large stove, a large pan, in it some oil - and a Tele-body. Roast on each side for 3 minutes, because: science has found that this procedure leads – for beef – to a huge increase in flavor. For the guitar, it's similar …

But seriously: **Deep-freezing** (DCT, deep cryogenic treatment) generally speaking is not nonsensical. The method is known and it's used, e.g., for tool steels. Or for racing engines, or other highly stressed metal parts. The benefit: increased hardness, retention of sharpness, ductility, abrasion resistance, service life, in short: everything that's important for drills, milling cutters, and the like. When it comes to the electric guitar, only those who completely wear down their Strat vibrato every 6 months should think about cryo-treatment. For steel strings ... not completely nonsensical … might be worth a try. If the tensile strength (breaking load) is increased, and nothing else gets worse ... better ask some metallurgists. With wound strings, however, fat (tallow, dust ...) will settle in the grooves of the wrapping despite the cryogenic treatment, and <u>that</u> is in essence the sound killer, since a "more homogeneous molecular structure" won't help at all.

Of course, charging € 600.- for cooling down complete electric guitars is lucrative business - purely on the basis of the promise that the sound would somehow be better: *"High-frequency and harmonic vibrations are significantly reduced or eliminated by de-stressing the workpiece"*. If harmonic vibrations are significantly reduced, are then inharmonic vibrations amplified? Just how nonsensical all this is can be seen from the controversial statement: *"Guitars that have received a cryo-treatment sound much more harmonious"*. Here, all and any nonsense that the ad writer can come up with is thrown in: *"Cryogenizing hi-fi and audio devices, as well as amplifiers for electric guitars and electric basses, makes for a richer sound. On CDs treated that way, bass frequencies were more contoured and comparatively louder"*. However: *"Due to the structural change of the conductor, you have to expect a new playing-in time* (i.e. a time until the instrument or device has its optimum sound)*, which is different depending on the cable."* That's very much like the "Schlock". Don't forget: *"Holes in the internal structure of the material prevent the oranised movement of electrons* (sic)*."*

[⊕] More precisely e.g. in Rösler, Harders, Bäker: Mechanisches Verhalten der Werkstoffe, Teubner, 2003.

The improvements found in cutting and bearing metals apparently translates 1**:**1 to guitar woods, pickups, switches, pots, jacks, cables, just about anything that can make somebody some money. One violin-maker says that treated wood is much easier to work with because it is absolutely **relaxed** after treatment. The next one says that after the treatment, the **service life** would be extended, and another one confirms that **the tone sustains longer**. An enterprise located in the neighborhood (dealing in screws, perhaps?) has identified further areas of application: *"Deep relaxation through cryo-screwing! Weekly changing experts (m/f) guarantee longer service life!"* The fact that occasionally lacquer or bindings tear open can also be seen as a positive: *"The sound gain through the broken up paint is extremely clear to hear and feel."* That's for a solid-body guitar, mind you. Brass instruments, too, benefit: *"less blowing resistance, rounder resonance-tone."* A counter-opinion: *"I was unable to detect any differences in the instruments after cryogenic treatment that I could attribute to the treatment* [trumpet forum]*"*. Let's hear from another fellow contributing to the thread*: "I imagine that somehow it would be interesting to investigate the **placebo** effect: just go and pay 500 Euros, and store a guitar for 4 weeks somewhere in some closet. And then: it was really worth it, that's the sound!* [Tsb.olaf]*"*. This last comment at least gives some hope: there's still a bit of sanity in this world.

Placebo! And many feelings of inferiority that must be concealed via gimmicks. If it can't be that guitar for 100,000 Euros, then at least get a cryo-jack. If playing Highway Star isn't working out all that well, then at least the electrons in the tuned cryo-cable should. Onto which we should clip a "Schlock", as we've learned. And, finally, a tip for the home stereo system (or the home studio): we all know from physics that cables lying on the ground transmit bass sounds not as well (Faraday's ground effect). Ultramax has recently launched the Cryno-Cablespacer, which keeps the speaker cable at a constant 9.4 cm above the floor (recommended spacing: apply a Cablespacer every 10 cm). Cryno is a completely new development: two different nanometals are alloyed into a bimorph, and then optimized with cryo-tuning. The fact that these fullerenes have excellent properties has been proven for a decade – but only now has Ultramax managed to maintain stability in production. **5 year warrantee**! On its way from the amp to the speaker, the cable is supported every 10 cm, so that a constant capacitance area sets itself up, providing an optimum stationary-wave load to the speaker current. Audibly better transients, because wave dispersion no longer occurs; fuller bass because the Faraday effect is compensated. Optimal stereo processing, due to the matching of the group delay. PPP only €997,00 (excl. VAT). Ask your high-end dealer for it! If he is not stocking the Cablespacer yet, stop being a customer there! You owe it to your ears, after all: you only have these two … … and hopefully no hollow waveguide in between!

Actually, Norman, our sales guy (see above) was unintentionally close to hitting on the truth: *"All these **fakes*** (sic) *are only the tip of the iceberg"*. A small spelling mistake – excusable. No, not facts, indeed it should have spelled **fakes** ... [1]

Source: www.sg-akustik.de; Free delivery!

Despite the absurdity shown on the left: listening tests with professional guitarists who were initially convinced by the sound of "their" cables, proved unambiguously: in a blind test, the professional simply cannot hear any differences in speaker cables; for guitar cables, though, differences are easily audible, but the cause is exclusively the cable capacitance. Other quality factors are limited to mechanical properties, and possibly to the shielding effect.

[1] *translator's note: ... a term that since the year 2017 has attracted a lot of attention even in the White House, for better or worse.*

