Stan's Safari 16

STAN TIPTOES WITH TREPIDATION INTO THE MURKY JUNGLE OF HI-FI CABLES

In my series of columns I've touched on most audio system components but have hitherto largely steered away from cables. This has been deliberate, for I know of no other topic in the world of hi-fi that arouses such passions and incites so much aggravation. From one perspective they encapsulate everything that is irrational about high-end audio – "cables costing £2,000 per metre, for Gawd's sake". Some manufacturers could embarrass old-time snake oil purveyors with their claims and theories, few of which stand up to even the most cursory scientific examination.

Some months ago I proposed subjecting a number of cables to a thorough examination to see if there were any correlations between measurement and sound quality. Both myself and the Editor were rather taken aback by a vehement unwillingness of most manufacturers to participate. Ostensibly this was because I had previously done some work for a UK cable manufacturer – but then I've assisted many others previously: amplifier manufacturers; loudspeaker manufacturers; digital audio manufacturers; even coal mine safety manufacturers (yes, really), without problems. No, I simply suspect they felt it would be better all-round if high-end cables remained shrouded in their own world of parallel science.

With this avenue closed, I began to muse on the topic while trying to sort some of the wheat from the chaff. But where to start, because amazingly conflicting arguments are put forward? One company will claim that the 'cleanest' signal path is best with minimal resistance, capacitance and inductance, and even crimped or welded connections to avoid solder. Another will add resistor-capacitor time constant networks in parallel with the conductors to 'correct' signal timing errors. Some promote flat ribbons, while others produce co-axials so thick they could do useful duty as tow-ropes. Then there are the single strand-versus-multi-strand arguments, and so it goes on. How does the poor enthusiast make sense of this, when it's impossible for such opposing views to both be right?

Let's start with conductor purity. Most of us would intuitively agree that our cables should use pure metal conductors because nobody would seriously consider using rusty barbed wire as loudspeaker cables. But how pure does the conductor need to be and why?

When I first entered the world of hi-fi everybody used two-core mains cable for loudspeaker connections and such cable used commercial grade TPC (tough pitch copper) of about 99% purity. In today's parlance that would be '2N' copper because metal purity is normally expressed by the shorthand term "Nines" or "Ns" which refers to the number of figure 9s in defining the level of purity.

Today high purity copper is readily available and comparatively inexpensive. 4N purity means that the material is 99.99% copper with just 0.01% of impurities whilst a 5N copper bar is 99.999% pure with impurities of below 0.001%. Such metal ingots are normally free from oxygen, nitrogen and carbon and are stored in sealed containers under vacuum or inert Argon. Copper of up to 8N purity is also available, but should be drawn and coated immediately to avoid oxidation through exposure to the atmosphere.

Many manufacturers prefer conductors made by the Continuous Casting (OCC) process originally developed by Professor Ohno at the Chiba Institute of Technology. Here conductors are drawn from a single crystal ingot ensuring far fewer crystal boundaries along the cable. Ohno's research found that impurities would gather at boundaries, so it's logical to reduce the number of boundaries in order to reduce the level of impurities. Some manufacturers claim that the conductors in their cables are single crystals, but in truth the heating and drawing of the copper to produce fine copper wires degrades the material. No longer a single crystal, it nevertheless retains a more uniform structure than the highly granular form of less pure copper. But how does this improved purity and structure come to effect the performance and hence the sound?

Many cable manufacturers happily publish crackpot theories dressed up as facts and with little science, but there is some. Several recent papers shed some light including 'Frequency Dependence of Resistivity of High-Purity Copper at Low Temperatures' by Nakane, Watanabe *et al*, which supports the supposition that the signal electrons are more mobile in a uniform crystalline structure. The graph below (*Fig.1*)shows the behaviour of some test conductors of different levels of purity and it can be

Fig.1