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ESOTERIC LOUDSPEAKER CABLES, DO THEY REALLY DELIVER THEIR PROMISES?

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Abstract
Two thousand pounds or more is no longer an unduly rare amount of money to be spent on a pair of loudspeaker cables, yet many people in professional audio circles are strongly resisting being drawn into any consensus that such cables make convincingly significant audible differences to a system. Many people cite secondary or tertiary effects of the cable installation procedures as the main source of subjective improvement: general care and attention to detail such as clean, tight connectors, careful cable routing and well soldered joints being typical examples put forward for the case against any directly attributable cable benefits. "Show me conclusive evidence in terms of Ohm's Law" is another often heard demand from the non-believers. The over-hype by the hi-fi magazines has probably done nothing to persuade many of the more conservative professionals that there is any significant substance in the case for such esoteric wonders; yet all along the line, too many people who I personally respect, have been convinced of the benefits of certain special cables for me to have ever been inclined to dismiss their benefits out of hand.

Debate continues on the subjects of oxygen free and linear crystal copper versus conventional copper; co-axial versus twin cables; optimum strand thickness with relation to skin effects; silver solder versus tin/lead solder used in terminations; insulated versus uninsulated strands in any one bunch; insulating sheath materials; directionality in terms of one specific end to the amplifiers and the other specifically to the loudspeaker, in other words, non-reversible cables; shielding from external magnetic fields, both lf and rf; general transmission-line properties; and many other controversial areas of discord. Such discussions may be working wonders for the sales figures of the hi-fi magazines, but for the industry in general, it can be doing its credibility no good whatsoever.

General Good Practice

Obviously, any reasonable cable is likely to sound better when compared to an excessive length of poorly terminated bell flex. As a general rule, good quality, well terminated, 60 amp, multi-strand, conventional copper wire would seem to be adequate for

most purposes. At about £1 per metre for a pair of conductors, the price would also seem realistic for most applications. Minimum cable lengths between the amplifier and loudspeaker driver is a virtually self evident rule of thumb, as obviously at the extreme, zero length can cause zero effect. Conversely, 8 Ohms in an absurdly long length of cable will have untold negative repercussions of the performance of a 4 Ohm system.

From our findings to date, the noticeability or otherwise of cable deficiencies is least noticeable on electronically crossed over, multi-amplified systems, and most noticeable on systems with high level passive crossovers, particularly those displaying tortuous dynamic load impedances. An extreme case of the latter is the Hidley/Kinoshita system whose crossover input impedance drops to around 0.8 Ohms at certain frequencies. Given the system power rating of 1000 watts, on complex musical drive signals, it is not unfamiliar to see transient currents in excess of 100 amps when the systems are driven at high SPL's via their JDF 3200 watt amplifiers. On these systems, JDF supply oxygen free cables, with depolarised outer screen, directional conductors and overall one specific end to the amplifier directionality. I mention these systems as due to their extreme demands, they have proved to be useful test beds for the highlighting of more general trends.

The amplifier to crossover cable would seem to be more critical than the cables from the crossover to the loudspeakers. The amplifier/crossover cable should be as short as possible as it is in the crossover where the highly complex dynamic loads are realized. If any significant distance exists between the amplifier and the loudspeaker, then the crossover should be brought as near to the amplifier as possible in order to minimize the distance over which the cables are subject to highly reactive loading. It is also over this length of wire that the complex back emf's from the entire system will impose themselves on the feedback circuits of the drive amplifiers. Whatever impedance or irregularity occurs in this length of cable will form the top half of a potential divider network, the lower half being the output impedance of the amplifier, across which the overall feedback circuits derive their error signal. Any r.f. or other spurii which may superimpose themselves on the crossover/amplifier cable, including any non-linear conductivity as suggested may be caused by inter-crystal boundaries in the conventional copper cabling, will again modify the feedback signals. I would suggest that some of the benefit attributed by some audiophiles to amplifiers without negative feedback may be partly due to their general immunity to the above effects.

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If the benefits of good quality, short cables are to be realized however, the potential for non-linear conduction in this area is greatly exacerbated by the other inter-metal contacts which could include a tined transistor leg soldered to a copper printed circuit track, in turn soldered (tin/lead) to a copper wire which may be crimped or soldered to a brass eyelet tag, clamped via a steel serrated washer to a brass terminal, in turn connected to a chrome plated banana plug or spade connector,... and that is only at the amplifier end. The chrome plated spring connectors on the loudspeaker chassis are notorious for suffering oxide build up over a matter of only a few months. In fact, chrome retains its shine by virtue of a thin film of oxide which forms on its surface immediately upon its contact with air. The effect of a short length of adequately current rated, well terminated good quality copper conductor would appear to be small when compared to the other potentially non-linear conductors in the circuit. There are people who say that ABX testing of such sensitive naunces via a switch or relay system is invalidated by the introduction of a switch contact into the circuit. I cannot find any justification of this neurosis either by experimental measurement, by listening, or by intellectual reasoning, when the circuit contains such interconnections as described above.

Conductor Geometry and Skin Effect

The overall cross-sectional area of the conductors must be adequately capable of passing the highest dynamic currents likely to occur on any given system, without any instantaneous temperature induced resistance rises sufficient to be detected audibly. Cross section will be a function of overall length and inherent resistance per linear unit. The individual number of strands which form that total cross-sectional area are the subject of heated debate. Once again, the problem seems to be aggravated by difficult dynamic loads and minimalized by active crossover/multi-amplifier drive systems. In the latter, in a typical four-way system it is unlikely that any cable would be handling more than four octaves. In a passively crossed over system, eleven octaves can make more stringent demands on the transmission line linearity of a pair of loudspeaker cables. Indeed, as an extension of this principle, even in a passive, high level system, it is only the amplifier/crossover cable which carries the full, wide-band programme.

Some manufacturers sing the praises of cables composed of hundreds of hair-like strands in order to maximize the ratio of surface area to cross section,...the skin area, whilst others claim that this approach maximizes the potential for surface corrosion and inter-strand non-linear conduction due to the

copper oxide rectification principle. It has also been claimed that individual conductors of the size of typical telephone installation wires are the optimum choice for the skin/core balance of current flow. Still other manufacturers insist that such strands must be individually insulated in the bundle, both to reduce the problems of long term corrosion and to prevent the cable impedance from varying due to the randomized inter-strand contact varying as the cable is moved, either by vibration or for re-location.

I have found manufacturers claiming skin effects become significant at around 10kHz, whilst other people claim that the effect is evident from 1kHz. I have also met some experienced and learned people who claim that such effects could not be evident until 100kHz or more.

Group Delays and Insulating Materials
As with the variability in the claims for skin effects, there are factions who support the concept that transmission line group delays must be considered in monitor system design. Again, others contest that such group delays as do exist are usually only in the region of micro-seconds and are clearly irrelevant to audio applications. Signals reflected back from the non-ideal terminations at either end of the transmission line which the loudspeaker cables constitute, do have finite "lives" within the lines and can once again, if present to any significant degree, superimpose themselves upon in particular, the feedback "error" signals. The question is, just what degree is significant?

Insulation materials are dielectrics which exhibit charge migration under certain high level drive conditions, "bouncing back" again a finite time after the cessation of the drive signal. As with group delays, to what extent are these effects audible and under what circumstances.

Another aspect of insulating material technology is the effect to which the insulation can inhibit or chemically advance the onset of surface corrosion. While this is not a directly audible effect itself at any given point in time, if such effects are evident, over what period of time do these system degradations occur; months, years, tens of years or lifetimes?

General Conclusions
Once a cable has been installed and approved, one very valuable asset for any cable to possess, along with the connectors to which it is attached, is consistency. Insidious changes in resistance or linearity of conductivity are alarming properties

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for any system to possess. The suspicion of a system deteriorating with time is unnerving both for the conscientious amateur and the professional alike. If one cannot trust ones monitoring to remain relatively constant, then the very foundation of one's judgement is undermined. If skin corrosion is both significant and promoted by certain insulation materials, then cables exhibiting such symptoms are clearly to be avoided. If cables with multiple strands do exhibit perceptible changes due to inter-strand contact irregularity when vibrated or re-located, then these potential variables would also be deemed undesirable, and cables exhibiting such properties should not be specified for any serious system.

Whilst realizing that real world applications often make strange demands upon system designers, I doubt that any system could be deemed to be well designed if it had power amplifiers 40ft away from the loudspeakers, especially if those amplifiers were in turn fed from a plugboard on the end of a similar length of not so heavy flex. May I open the debate however by saying that a well designed, well installed system; with amplifiers close coupled to the loudspeakers, if necessary having one amplifier adjacent to each loudspeaker as opposed to a common stereo amplifier necessitating longer loudspeaker cables; will perform optimally using Mk 1 copper cable of adequate cross section. I submit that the more esoteric cables are a means to an end. They may solve the problems of difficult installations or particularly tortuous dynamic impedances, but in general, a well selected, conventional copper cable of adequate current rating, short length, and optimum strand configuration for the application, when well terminated will perform equally well.

Pistols at dawn on the French coast anyone?