AUDIO TALK

by LEO SIMPSON

Loudspeaker cables and their mythology

In the last couple of years or so, there have been quite a number of new products and new product features which have been introduced to the high fidelity market. Some of these have been worthwhile, but others have been of quite dubious benefit. Into the latter category must be placed the new special cables for loudspeaker connection.

A few years ago a set of these cables was submitted to us for review. The claims made for the cables made us shake our heads in amused disbelief, and we rejected the product for review. In retrospect, it might have been better if we had reviewed them, for they could have been debunked there and then.

The proponents of these cables, mainly Japanese manufacturers, have started from the premise that conventional loudspeaker cables have inductance. From that premise, they go on to state that because inductance in a cable will attenuate high frequencies delivered to the load, then conventional loudspeaker cables are inadequate and cause poor definition in sound reproduction.

So the manufacturers have produced a variety of special cables which are claimed to have very low resistance and very low inductance. The advantages of the cables are documented in response curves which purport to show the typical high frequency attenuation of conventional cables and the improvement obtained with the manufacturer's cables.

In some cases, the manufacturers go so far as to quote the characteristic impedance of their cable. Typical figures quoted are in the region of 8 to 10 ohms. They go on to state that the characteristic impedance of the normal twin-leader (or figure-8 cable) used for connecting speakers is much higher and therefore, by implication, that twinlead produces a severe mismatch. This is absolute nonsense.

By quoting figures for characteristic impedance the manufacturers are suggesting that speaker cables act, or should act, as transmission lines, in much the same way as a length of 300-ohm TV ribbon does. In other words, the cable is supposed to act as a constant impedance system which matches its termination impedance and transfers signals over long distances with minimum losses and reflections.

Now it is a fact that the impedance of a loudspeaker system varies widely with frequency. For example, a typical two-way loudspeaker system with a nominal 8-ohm impedance may vary from 30 ohms at its fundamental resonance to less than 6 ohms at the cross-over frequency. Over the rest of the range, the impedance may be highly capacitive or inductive. So a loudspeaker represents a very poor termination for such a transmission line.

But the main reason for rejecting the transmission line concept is that it only applies where the length of line is many times greater than the wavelength of the signal concerned. The electrical wavelength of a 20kHz signal is no less than 15 kilometres. So anybody who considers that a loudspeaker cable acts like a transmission line is definitely on the wrong wavelength (pun intended).

Having rejected the transmission line concept out of hand, we decided to examine a typical set of these cables closely. We would measure them and make comparison tests with conventional cable. The pair we examined were of Japanese manufacture. Instead of the usual moulded "figure-8" cross-section, these special cables are of circular cross-section.

The circular cross-section is obtained by plaiting a large number of varnished conductors around a 6mm circular core of clear plastic. The plaited cable has an overall sheath of clear plastic which protects it. At each end of the cable are brought out to two separate conductors which can be connected to speakers and amplifier.

Presumably, the plaited construction cancels the self-inductance of the cable. We would expect the inductance to decrease by comparison with ordinary figure-8 cable, although the capacitance should also increase. The manufacturers of all these cables make no mention of the capacitance.

We were intrigued with the circular plaited construction of these cables and struck by the superficial similarity to the old Litzendraht wire used in radio frequency circuits. "Litz" wire, as it was more commonly called, was composed of a large number of finely interwoven conductors, each separately insulated. This method of construction was adopted to provide a large surface area for a given length and cross-section of conductor. The large surface area was desirable to combat Skin effect, which is the tendency of RF signals to travel near the surface of a conductor and thus increase the effective resistance.

Just in case any reader is wondering, Skin effect does not occur at audio frequencies. It would be interesting to know if anyone has been "conned" into buying these cables by just such an argument.

For what it is worth, other competing brands of these "super" cables have different construction. Some are plaited into a flat cable form, while others look like conventional shielded cable.

We decided to compare the round cable described above with a 10-metre length of 23/0.19mm figure-8. The specifications given for the "super" cable were as follows: Length 6 metres; DC Resistance .0105 ohm/metre; Inductance 0.15uH/metre; Characteristic Impedance 9.15 ohms.

We tested the two cables by measuring their insertion loss when driving an 8-0hm resistive load and also a typical two-way bass reflex loudspeaker system. The figures are taken at four frequencies as tabulated below.

8-ohm resistive load:

	Super cable	twin 23/0.19mm
100Hz	—0.15dB	—0.5dB
1kHz	—0.15dB	—0.5dB
10kHz	—0.15dB	—0.6dB
100kHz	—0.1dB	—2dB

The results for the 8-ohm resistive load are interesting for a number of reasons. First, the insertion loss of 0.15dB for the super cable suggests that it has a total resistance which is about twice that calculated by multiplying its length by its quoted resistance per unit length. (The reduced insertion loss at 100kHz is probably due to inductance in our dummy load resistors.)

Second, the results for the 23/0.19mm figure-8 cable are as expected from calculations. Its total resistance is approximately 0.5 ohms, which should produce an insertion loss of 0.5dB at audio frequencies with an 8-ohm load. Notice that it only suffers by comparison with the super cable at 100kHz, where the insertion loss is 2dB. Maybe some music containing these frequencies has been composed for dolphins and bats, but I have not heard of it.

When used to drive a loudspeaker system the results were as tabulated below:

	Super cable	Twin 23/0.19mm
100Hz	—0.05dB	—0.15dB
1kHz	—0.25dB	—0.7dB
10kHz	—0.25dB	—1.0dB
100kHz	—0.1dB	—1.6dB

Here the effect of the widely varying impedance of the loudspeaker system is evident. At 100Hz, its impedance is high due to a bass resonance effect, so the insertion loss of both cables is low. At other frequencies within the audible range, the disadvantages of the figure-8 cable is less than 1dB — which is negligible. Note also that any non-linearity in the frequency response caused by the speaker leads is minor compared to the overall non-linearity of the speaker itself.

We also made comparisons of both cables feeding a 10kHz square wave to the same loudspeaker. We found the deterioration produced by the figure-8 cable so similar to that of the super cable as to be virtually impossible to distinguish from oscilloscope patterns, and it was not worth taking pictures. And oscilloscope traces of the tweeter output when driven with a 5kHz square wave via either cable were virtually identical in waveform and only slightly different in amplitude.

This is not surprising. After all, a typical tweeter can only handle the fundamental, third harmonic and fifth harmonic of a 5KHz square wave. The end result does not look much like a square wave! So any talk about the high frequency attenuation of conventional loudspeaker cable is largely academic. The one advantage of the "super" cable is that it has a very low DC resistance.

Low DC resistance is important in speaker cables. It enables the amplifier to provide maximum damping effect for the loudspeaker and thus helps ensure clean bass and lower-middle frequency reproduction. For this to occur, the DC resistance of the cable should be no more than 0.5 ohms. This would explain the improvement in clarity obtained by some users of the super cables — many of these users previously had higher resistance speaker cables.

But there is one parameter of the super cables that the manufacturers conveniently neglect to mention. That is capacitance. We said before that capacitance would be higher than for conventional cables, but we were surprised to obtain the figure for a 6 metre length of cable: no less than 0.01uF! Now this is in the range of load capacitance for which some amplifiers are at least marginally unstable at supersonic frequencies.

At a low level, supersonic oscillation can give a subtle "edge" to the sound quality. At high levels, supersonic oscillation can cause quite unpleasant sound quality as well as amplifier overheating and possible failure. We have a well-known and respected American power amplifier which we know to be very slightly unstable with capacitances in the range of .0033uF to 0.01uF. Sure enough, when we tested with the super cable, it became unstable. Enough said!

There is really only one conclusion to be drawn from all this: Low resistance speaker cables are desirable, but the new super cables are not the way to go. Apart from their extortionate cost at more than $30 for a pair of 6 metre cables, they can cause problems with your amplifier due to the significantly increased capacitance.

A better way to ensure that your loudspeaker leads have low resistance is to use 23/.019mm figure-8 flex, or heavier cables. Unfortunately heavier cables are not really readily available, although they are manufactured for the automotive trade in large quantities. "4mm auto cable" which is readily available from auto accessory stores is eminently suitable, although it is necessary to purchase four lengths to make up a pair of cables, for two loudspeakers.

Alternatively, contact Audiosound Electronic Services, of 148 Pitt Road, North Curl Curl, NSW 2099. They stock a range of heavy gauge figure-8 flex for use as speaker cable.

"Measurements aside, Bruce, these new special loudspeaker cables really do make a difference".