cable mojo and urban-legends

It seems to be traditional to rip off musicians, and often we set ourselves up for it by being both uninformed and eager to have the very best sound possible. The latter is a good thing but being uninformed is expensive and just plain stupid. Sadly, we often unintentionally rip each other off by passing on the myths that we have been indoctrinated with. There are a lot of companies out there selling premium this and premium that – I'm sure most of them are run by very sincere folks who really believe in their product. Unfortunately, many of those sincere folks simply don't have the technical background to evaluate the accuracy of their beliefs.

In this article we'll look at the characteristics that make up a good instrument cable and the characteristics that make up a good speaker cable. What's absolutely critical on one is of little importance on the other (failure to understand this has given rise to many of today's myths and costs musicians millions of dollars annually). Finally, we'll look at some of the "buzz-words" and "features" used to sell cables – by describing what those "features" really mean you will be able to see for yourself that many of them are unnecessary hype as applied to instrument cables, speaker cables, or both.

First, let's consider the instrument cords that connect your guitar to your amplifier, chain together your stomp boxes, and so on.

These cords are operating in a high-impedance, small-signal environment. That simply means that they are "feeding" an amplifier or other device that has a high resistance (many thousands of ohms) path to ground. Furthermore, they are carrying a tiny current that is measured in thousandths of an ampere, and a very small voltage. All of these things make them quite susceptible to noise from electromagnetic interference. Also, because they are most often connected to a device that has a fairly high output impedance, such as an electric guitar, cords with too much built-in capacitance will bleed off high frequencies badly, especially over long runs. All shielded cords have some capacitance, the goal is to get wire having as low a capacitance as possible.

Critical factors for a guitar cord or other instrument patch cord:

- **Low capacitance** – to prevent high frequencies from being lost.
- **Good shield coverage** – to block noise from EMI.
- **Physically rugged** – because they typically take a lot of abuse.

"But wait!" you say. "What about low resistance? I don't want to lose signal volume in the cord!" Remember we said that these cords are feeding a high resistance? Even the cheapest, crummiest, tiny-gage copper wire you can find is only going to have a few ohms of resistance over a run of 100 feet or less. In practical terms, there is no difference between a few ohms of resistance and zero resistance when you are feeding an amplifier with an input impedance that is many thousands of ohms. **(Of course, that extra-cheap wire is going to be unsuitable for other reasons – it will probably have very high capacitance and poor shielding.)**

Now, let's consider the speaker cables.

Speaker cables operate in an environment that is exactly the opposite of that for instrument cables. Speaker cables connect the low impedance output of an amplifier with the low impedance of loudspeakers. Furthermore, they carry a relatively high current and voltage. Consequently, these cables aren't very susceptible to noise from EMI but the circuit is **very** intolerant of high resistances in these cables.

Critical factors for a speaker cable:

- **Low resistance** – to prevent signal loss.
- **Physically rugged** – because they typically take a lot of abuse.

"But, what about shielding and capacitance?" you ask. Neither are critical in this low impedance circuit. Only an incredibly powerful EMI source can make an impression on the high-current, low impedance main signal. (It's not utterly impossible, though. On one Air Force base I was stationed at every time I drove by the radome the sweeping radar would make my car speakers beep even when the stereo was turned completely off.) As for capacitance, even a fairly significant capacitance will still have an impedance that is outrageously high compared to the output impedance of the amplifier, and thus will have little impact on the high frequencies.

Let's burst a few bubbles and explode a few myths.

First, let me state that I believe that most of these myths are begun and perpetuated by well-meaning folks who simply don't have the technical background to separate fact from fiction. There are doubtless a few manufacturers and retailers who knowingly exploit the average musician's ignorance – but I like to think they are the minority. So, the next time that "tech" at your favorite guitar store tells you that you really need such-and-such remember that he probably has little or no formal electronics education or experience – he's just parroting what he's heard from others.

Likewise, take with a very large grain of salt the wisdom of your buddy with the "golden ears" who swears he can hear the difference between an oxygen-free copper guitar cord endorsed by a famous guitar hero and any decent quality cord. It would be nice if you could force him to prove it in a scientifically conducted double-blind test – but such folks never let themselves be confused by the facts. **It's entirely unproductive to argue with that sort of person – but that doesn't mean that you have to waste <u>your</u> hard-earned money on <u>their</u> fairy tales!**

Many very expensive myths are the result of applying the critical attributes of speaker cables to instrument cords or vice versa. For example – it is critical that speaker wires have low resistance – and resistance decreases as wire diameter increases – so large gage wire is good for speaker wires. Unfortunately, many musicians then apply the same logic – bigger must be better – to instrument cords. That's an expensive misunderstanding of what makes a good instrument cord!

Let's look at a few specific myths:

- **"Oxygen-free copper wire"** – I don't know whether to laugh or cry every time I see this. The claim usually made for oxygen-free copper wire is that it has less resistance and therefore less signal loss. As we've already mentioned above **resistance is of little consequence in instrument cords**! Resistance is very critical in speaker cables so oxygen-free copper wire should really help there, right? Wrong again! **You will get a greater reduction in resistance at a lower cost by simply going up one gage using ordinary copper wire!** *Oxygen-free copper wire's real value is it's resistance to internal corrosion ("black wire rot" and the like). That's important in some applications but of no consequence in guitar cords and speaker cables.*
- **Gold-plated plugs** – can be of some value in certain applications. However, many "techs" and salespersons have elevated them to the status of a holy grail. Gold plating offers two advantages, lower electrical resistance and less tendency to tarnish or corrode. Unfortunately, the gold plating is much softer than nickle and tends to wear off rapidly when the plug is used a lot. If the gold plating is over nickle then this is no great loss but if the gold plating is directly over copper

or another base metal and the plug is cycled in and out of a jack frequently it can actually be **more** susceptible to corrosion than an inexpensive nickle-plated plug! I don't generally recommend gold plugs on instrument cords, especially a guitar cord that is disconnected frequently. Gold plugs can be of some value on speaker cables and low-impedance microphone cords particularly if they aren't unplugged frequently. Gold plating is also of some value, even in high-impedance circuitry, when corrosion is a major concern.

- **Extra-fine stranded wire** – the usual claim here is that wire of any given gage that is made up of more and thinner conductors is less subject to high-frequency signal loss than wire made up of fewer coarse conductors. That may be true – **at very high radio frequencies**. At the audio frequencies we are dealing with there is no significant difference between solid wire, coarse stranded wire, and fine stranded wire. They're all going to sound the same. The one place where finer strands **might** have an advantage over coarser ones is in the shield braid because the finer strands can be woven more tightly and thus give more complete shield coverage. More complete shield coverage means less EMI noise. But, just because the braid **can** be woven more tightly doesn't necessarily mean that it is!
- **Extra large gage** – monstrous cords are pretty unnecessary in **most** cases for guitar chords. As mentioned above, the tiny reduction in resistance over a standard cord makes no practical difference in a high impedance circuit like the input to a guitar amplifier. However, **sometimes** large-diameter coax also has lower capacitance and that can be useful where runs longer than ten or twelve feet are needed. Remember that the internal capacitance of the cable bleeds off high frequencies. The more capacitance to ground that exists between the guitar and the amplifier, the more the high frequencies will be attenuated. The lesson here is to use coax that has very low capacitance per foot and to use the shortest possible cable. That **doesn't** necessarily mean a huge gage is needed. Some of the lowest-capacitance, highest performance cords around use a very thin coax intended for scientific instrumentation and digital communications. Finally, if you need more than about 25 feet of cable I would **seriously** consider going to a wireless system.

The bottom line: I'm not saying that you should never buy "premium" guitar cords. They do offer some advantages in that they are often more ruggedly constructed, with improved strain relief at the connectors and so on. A couple of years ago a buddy asked me to put a right-angle plug on a Steve Vai signature cord he had – I have to admit that I was impressed with the workmanship and ruggedness of the connection at the plugs on that cord, it's the sort of work that I would do myself. If you're doing the weekend-warrior thing increased reliability is worth a premium – how much of a premium only you can decide.

If you're using long cords you may want to go to a "premium" cord in the hopes that the manufacturer was smart enough to use a low-capacitance coax (not necessarily guaranteed). However, don't buy hype! For a ten foot cable that is never going to leave your bedroom anything better than the cheapy "giveaway" cords will do fine. In a blind test most people can't hear any difference between the cheapest cord and the most expensive in runs of ten feet or less unless there is a lot of electrical noise to be picked up. Even then, most can't tell the difference between the least expensive cord with an adequate shield and the most expensive.

If you **are** going to buy "premium" cords then know what features you're looking for and what you can pass on. Some things to look for in premium cords are a rugged cable jacket, internal connections on the plugs being epoxy potted or hot-glued, heat shrink over the plug shells and at least the first inch or two of cord, and (when it can be determined) low capacitance coax.