The Truth About Guitar Cords

By Craig Anderton

If a guitar player hears something that an engineer says is impossible, lay your bets on the guitarist. For example, some guitarists can hear differences between different cords. Although some would ridicule that idea—wire is wire, right?—different cords can affect your sound, and in some cases, the difference can be drastic. What's more, there's a solid, repeatable, technically valid reason why this is so.

However, cords that sound very different with one amp may sound identical with a different amp, or when using different pickups. No wonder guitarists verge on the superstitious about using a particular pickup, cord, and amp. But you needn't be subjected to this kind of uncertainty if you learn why these differences occur, and how to compensate for them.
The Cordal Trinity

Even before your axe hits its first effect or amp input, much of its sound is already locked in due to three factors:

- Pickup output impedance (we assume you're using standard pickups, not active types)
- Cable capacitance
- Amplifier input impedance

We'll start with cable capacitance, as that's a fairly easy concept to understand. In fact, cable capacitance is really nothing more than a second tone control applied across your pickup.

A standard tone control places a capacitor from your "hot" signal line to ground. A capacitor is a frequency-sensitive component that passes high frequencies more readily than low frequencies. Placing the capacitor across the signal line shunts high frequencies to ground, which reduces the treble. However the capacitor blocks lower frequencies, so they are not shunted to ground and instead shuffle along to the output. (For the technically-minded, a capacitor consists of two conductors separated by an insulator—a definition which just happens to describe shielded cable as well.)

Any cable exhibits some capacitance—not nearly as much as a tone control, but enough to be significant in some situations. However, whether this has a major effect or not depends on the two other factors (guitar output impedance and amp input impedance) mentioned earlier.

Amp Input Impedance
When sending a signal to an amplifier, some of the signal gets lost along the way—sort of like having a leak in a pipe that's transferring water from one place to another. Whether this leak is a pinhole or gaping chasm depends on the amp's input impedance. With stock guitar pickups, lower input impedances load down the guitar and produce a "duller" sound (interestingly, tubes have an inherently high input impedance, which might account for one aspect of the tube's enduring popularity with guitarists).

Impedance affects not only level, but the tone control action as well. The capacitor itself is only one piece of the tone control puzzle, because it's influenced by the amp's input impedance. The higher the impedance, the greater the effect of the tone control. This is why a tone control can seem very effective with some amps and not with others.

Although a high amp input impedance keeps the level up and provides smooth tone control action (the downside is that high impedances are more susceptible to picking up noise, RF, and other types of interference), it also accentuates the effects of cable capacitance. A cable that robs highs when used with a high input impedance amp can have no audible effect with a low input impedance amp.

**The Final Piece Of The Puzzle**

Our final interactive component of this whole mess is the guitar's output impedance. This impedance is equivalent to sticking a resistor in series with the guitar that lowers volume somewhat. Almost all stock pickups have a relatively high output impedance, while active pickups have a low output impedance. As with amp input impedance, this interacts with your cable to alter the sound. Any cable capacitance will be accented if the guitar has a high output impedance, and have less effect if the output impedance is low.

There's one other consideration: the guitar output impedance and amp input impedance interact. Generally, you want a very high amplifier input impedance if you're using stock pickups, as this minimizes loss (in particular, high frequency loss). However, active pickups with low output impedances are relatively immune to an amp's input impedance.
The Bottom Line

So what does all this mean? Here are a few guidelines.

- **Low guitar output impedance + low amp input impedance.** Cable capacitance won't make much difference, and the capacitor used with a standard tone control may not appear to have much of an effect. Increasing the tone control's capacitor value will give a more pronounced high frequency cut. (Note: if you replace stock pickups with active pickups, keep this in mind if the tone control doesn't seem as effective as it had been.) Bottom line: you can use just about any cord, and it won't make much difference.

- **Low guitar output impedance + high amp input impedance.** With the guitar's volume control up full, the guitar output connects directly to the amp input, so the same basic comments as above (low guitar output Z with low amp input Z) applies. However, turning down the volume control isolates the guitar output from the amp input. At this point, cable capacitance has more of an effect, especially if the control is a high-resistance type (greater than 250k).

- **High guitar output impedance + low amp input impedance.** Just say no. This maims your guitar's level and high frequency response, and is not recommended.

- **High guitar output impedance + high amp input impedance.** This is the common, 50s/60s setup scenario with a passive guitar and tube amp. In this case, cable capacitance can have a major effect. In particular, coil cords have a lot more capacitance than standard cords, and can make a huge sonic difference. However, the amp provides minimum loading on the guitar, which with a quality cord, helps to preserve high end "sheen" and overall level.

Taking all the above into account, if you want a more consistent guitar setup that sounds pretty much the same regardless of what cable you use (and is also relatively immune to amplifier loading), consider replacing your stock pickups with active types. Alternately, you can add an impedance converter ("buffer board") right after the guitar output (or for that matter, any effect such as a compressor, distortion box, etc. that has a high input impedance and low output impedance). This will isolate your guitar from any negative effects of high-capacitance cables or low impedance amp inputs.

If you're committed to using a stock guitar and high impedance amp, there are still a few things you can do to preserve your sound:
The Truth About Guitar Cords

- Keep the guitar cord as short as possible. The longer the cable, the greater the accumulated cable capacitance.
- Cable specs will include a figure for capacitance (usually specified in "picofarads [pF] per foot"). If you make your own cables, choose cable with the lowest pF per foot, consistent with cable strength. (Paradoxically, strong, macho cables often have more capacitance, whereas light weight cables have less.)
- Avoid coil cords, and keep your volume control as high up as possible.
- Don't believe the hype about "audiophile cords." They may make a difference; they may not. If you don't hear any difference with your setup, then save your money and go with something less expensive.

Remember, if you axe doesn't sound quite right, don't immediately reach for the amp: There's a lot going on even before your signal hits the amp's input jack. And if a guitarist swears that one cord sounds different from another, that could very well be the case—however, now you know why that is, and what to do about it.