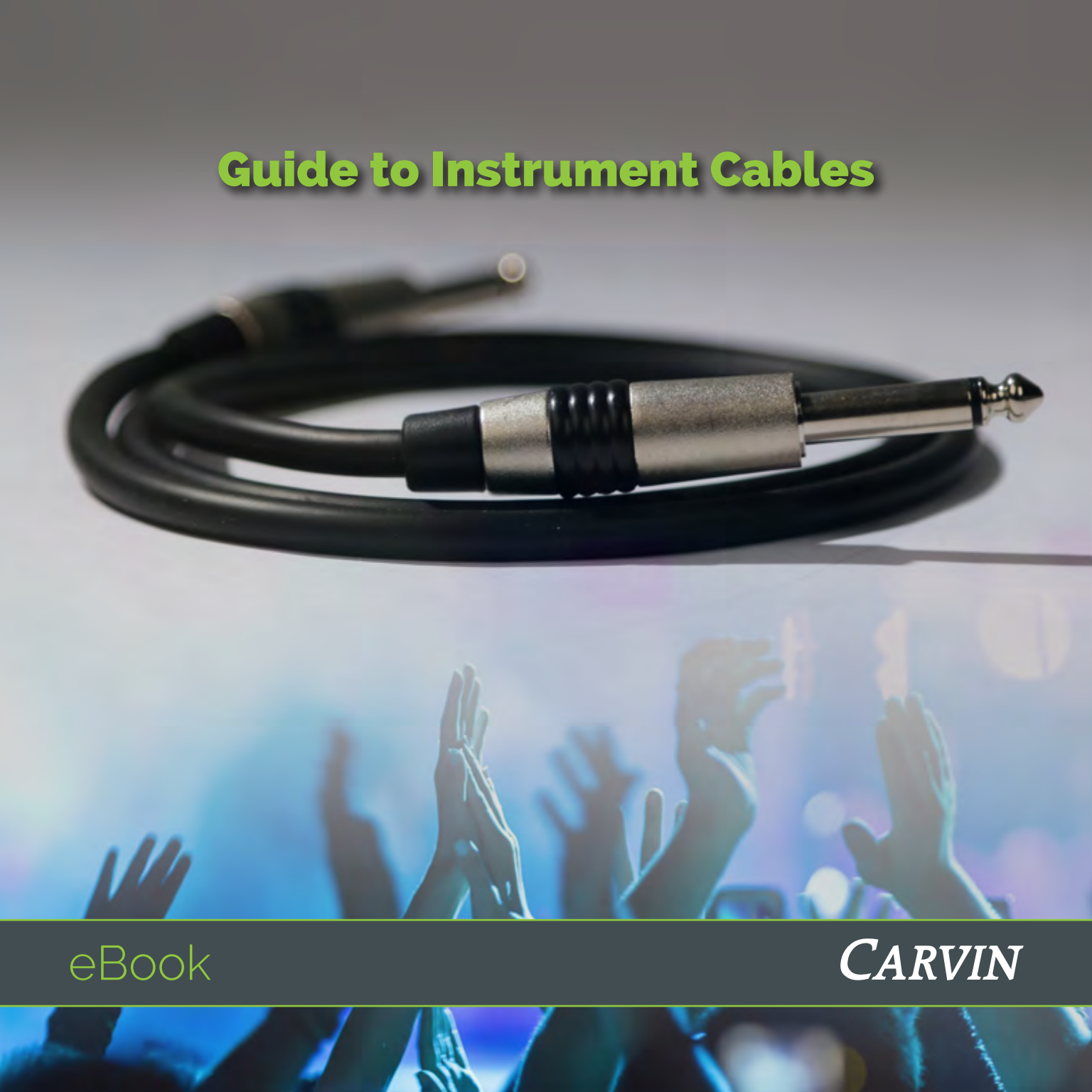
Guide to Instrument Cables



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A Guide to Instrument Cables

Most musicians want to play or record with the best possible sound. The journey to finding that "sound" includes a path to understanding cables. Sorting the truths and myths of cables can lead to frustration and unnecessary expenses. In this guide, we'll look at what makes a good instrument cable.

The Basic Connection

The first step to choosing a good cable is to realize that an instrument cord that connects your guitar to your amplifier operates in a small signal, a high-impedance environment. This allows you to feed a signal with a small amount of current and very low voltage to an amplifier or device that has a "high resistance path to ground." This signal is quite susceptible to noise from outside electro-magnetic interference, including power cords, cell phones, lighting, and more.

To combat interference, a good instrument cable must be well shielded. Shielded cords have some capacitance. Ideally, the cable should have as low a capacitance as possible. (Capacitance is the ability of a body to store an electrical charge, Inductance is the ability of a conductor to produce an electromotive force). This comes into play when a device that has fairly high output impedance and inductance like a guitar pickup combines with the capacitance from the cable you create a low-pass filter. Simply put, a cable with too much capacitance will have a degrading effect on high frequencies, bleeding off or "losing" them.

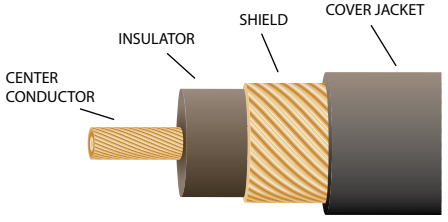
A cable is a "passive" component in your system and cannot add anything to your tone. If manufactured poorly, it can only lose aspects of a signal that it is fed. Some "high-end" cables have been designed to use high capacitance to "shape a signal," so that you will hear a difference in their cable over others, claiming more bottom-end or a more present midrange. This is usually at the expense of the signal or in many cases your wallet.

The resistance of instrument cables is not as critical as one might think, since it is connected to a device with a high impedance input. A small gauge copper wire that has a few ohms of resistance over its run will not have much of an effect on the circuits in an amplifier with an input impedance that is thousands of ohms. That doesn't mean resistance is not important. Loss of signal will occur if the signal has gaps of resistance to cross from inferior construction.

The basis for a faithful cable system starts with good construction and quality materials. Superb cables are made using the following materials: quality copper, consistent insulators, shielding, and covering, all finished with solid connectors. If your cable is made of sub-par materials, the life and the value of the cable rapidly approach zero. Here are the basics to constructing a good instrument cable: Low capacitance, good shielding, quality materials.

The Cable

The most important aspects of a cable include center conductor construction, insulator materials, shielding architecture, and cross section geometry. Oxygen-free copper wire is a common claim of wire manufactures. It is not unimportant, but the benefits are not what you would think. The benefit of oxygen-free copper is its ability to help prevent internal corrosion of the wire. With poor grade copper some manufacturers attempt to overcome the "narrowing" of the path as wire corrodes over time by increasing wire diameter. Oxygen-free copper allows for the construction to utilize a slightly thinner, more flexible wire in the system, a trait coveted in instrument cables. Its use can also be an indicator that the manufacturer is committed to using quality materials.



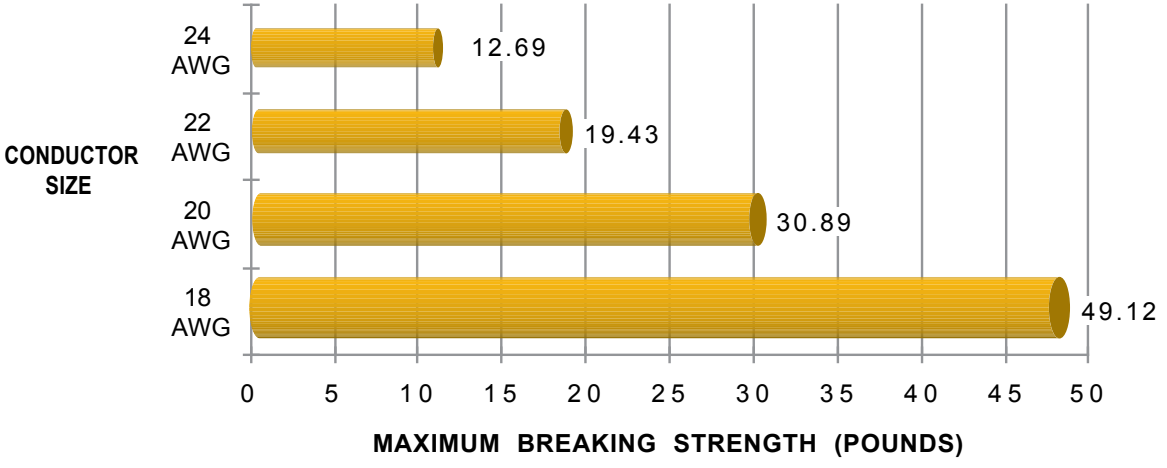
If a long run is necessary, a Direct Input box is highly recommended. Commonly called a DI, it will serve to convert the unbalanced, high-impedance output of your guitar to low-noise, low impedance balanced signal, capable of long runs.

Center Wire

Stranded wires of the same gauge can be made up of different sized strands. A cable with a "fine stranded" center conductor will be more flexible and have high resistance to failure caused by bending back and forth, but have less resistance to failure caused by being pulled. A cable with a "coarse stranded" center conductor will have a higher resistance to failure caused by being pulled, but have a less resistance to bending failure and it will be stiffer. The center conductor in a quality cable is more flexible, which will protect against bending failure, and combined with low-stretch insulators and covers with good strain reliefs will protect the cable from failure when pulled.

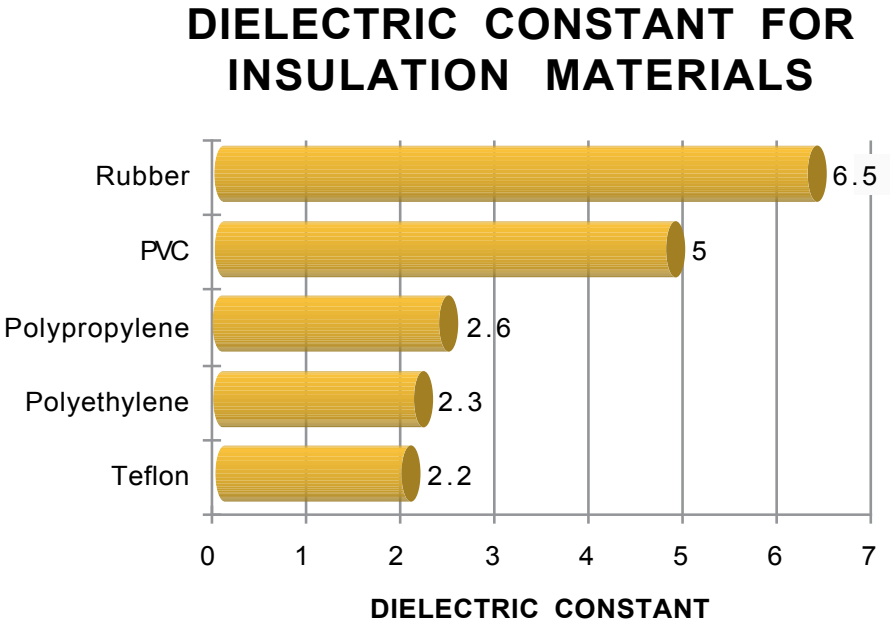
20 AWG has almost become a standard center wire size in instrument cables due to offering the best compromise between flexibility and strength.

COMPARATIVE BREAKING POINT OF CENTER CONDUCTOR



Insulators

The insulator, like the center conductor, has to walk a fine line between flexibility and effectiveness. If the cable is too stiff due to insulation diameter, the cable will not be very useful, especially on stage. If a cable has an insulation and construction method that is susceptible to uneven shrinkage, as with vulcanized rubber, it may offer inconsistent capacitance. The good news is that modern thermoplastics are ideal for this task and have largely replaced the older, inconsistent vulcanized rubber. There are many advantages to the newer materials. One of these is that they are very low-stretch and protect a flexible center wire when pulled.



New thermoplastics offer low capacitance and dimensional consistency.

Proper Handling
Another benefit in new insulators is their semi-conductive nature. When a wire is bent the shielding rubs against the covering and insulator creating static electricity, which causes undesirable crackling and pops. This was commonly dealt with by adding a semi-conductive layer on the center insulation to "bleed" off the energy. With newer materials the insulator itself has semi conductive properties, eliminating this step and insuring tighter dimensional tolerances.

Shielding
There are many ways to shield a cable. Foil and wire, twisted strand, and woven strand are the most common. For a cable that is bent and moved regularly as part of its job, woven is the preferred method for an instrument cable.

When you bend a cable with coarse twisted shielding, you can create gaps between the strands of the shield, and it quickly stops being a shield. Additionally with the foil system, bending the cable can pull the conductor away from the foil and compromise the shielding.

Fine woven strands or braids have an advantage. They bend together to give a more complete shield coverage. More shield coverage means less noise. Fine strands can be woven more tightly to provide the best coverage. Just because the cable uses braid, it doesn't mean that it is a fine braid.

Never do this...

Do this!

Shrink wrap method of strain relief

The crimp and flexible buffer allows for easy unplugging using the connector.

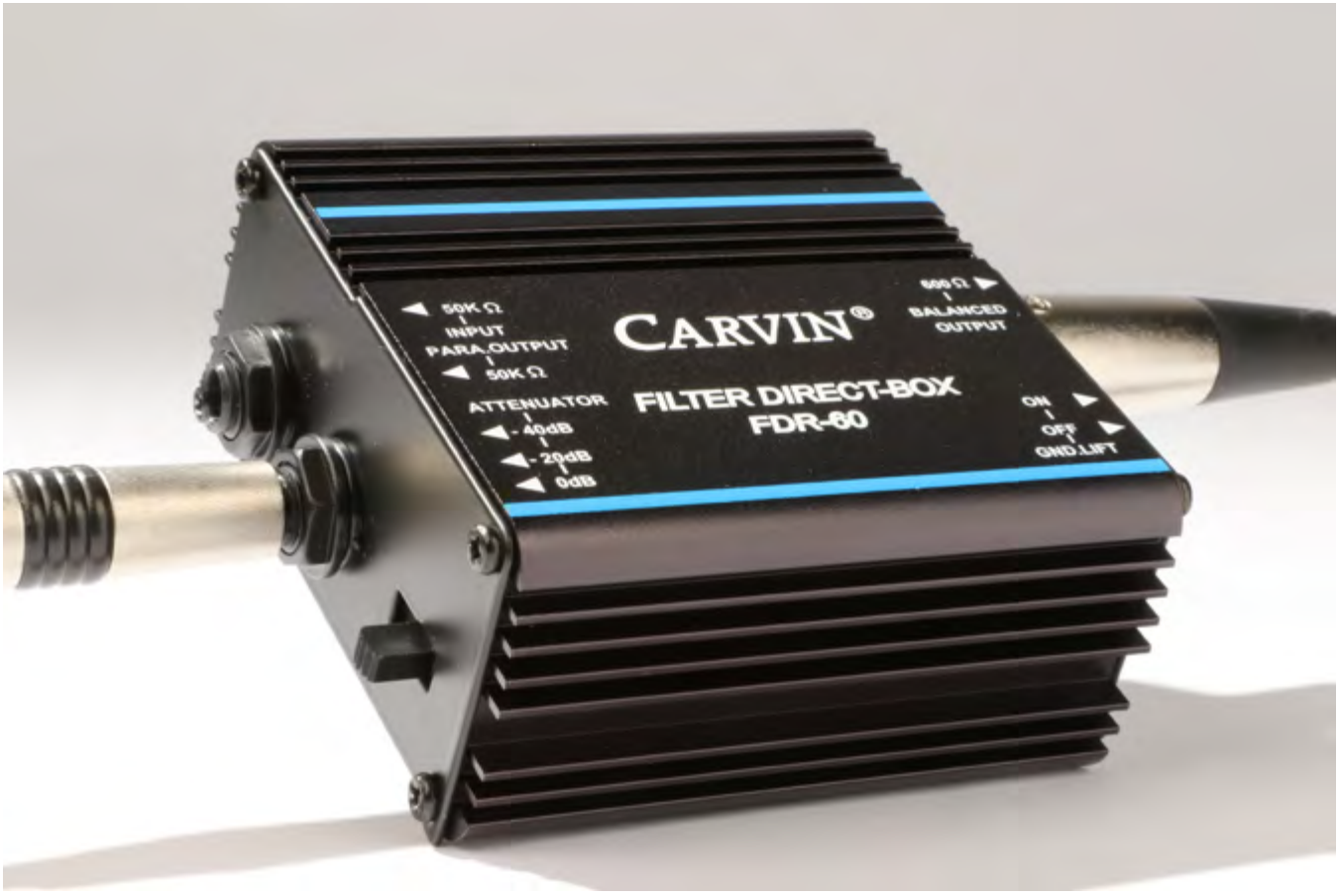
Covering
Coverings have to be durable, but also remain flexible, while introducing minimum handling noise. It has to be flexible, and at the same time durable, with little handling noise. A super durable covering can be too stiff, but a soft forgiving covering can compromise cable integrity and increase handling noise. A good cable will walk the line and sometimes even come in a color other than black.

Color does not improve cable performance, but can help identify the cable path.

Connectors
There are almost as many opinions here as there are with wire. The most important aspect to any connector is that it stays connected. Proper strain relief, durable construction, and good solder joints are the most important aspects of the plugs.

Gold-plated can be of value in a connection with its lower electrical resistance and less tendency to tarnish or corrode, but in a traveling environment it is not durable. Nickel is durable, (remember that instrument cables are being plugged and unplugged 1000's of times) and it will repeatedly give you a consistent connection. Gold is soft and is easily worn off exposing the base metal of the connector, which is vulnerable to corrosion.

Noise
You want to keep noise out of you system, especially 60-cycle hum. No matter the claims, instrument cables will not protect you from noise, if you are laying a coil right next to a power supply or on top of strip full of wall warts. The best defense against hum is to keep the coiled-up, or excess cable away from power sources such as amplifiers and power splitters.



Handling and Storage
When coiling your cables, never twist them. Make sure that all the tension is out of the cover and never wind them over your arm. This puts a lot of strain on the shield and center conductor and will lead to premature failure of the cable. Good habits in cable handling can save you from an inconvenient failure.

DI Boxes, Part of a Cable Plan
Earlier we had mentioned the use of a Direct Input box when faced with long cable runs. The humble DI box has been around for decades, but its benefits have not been outgrown.

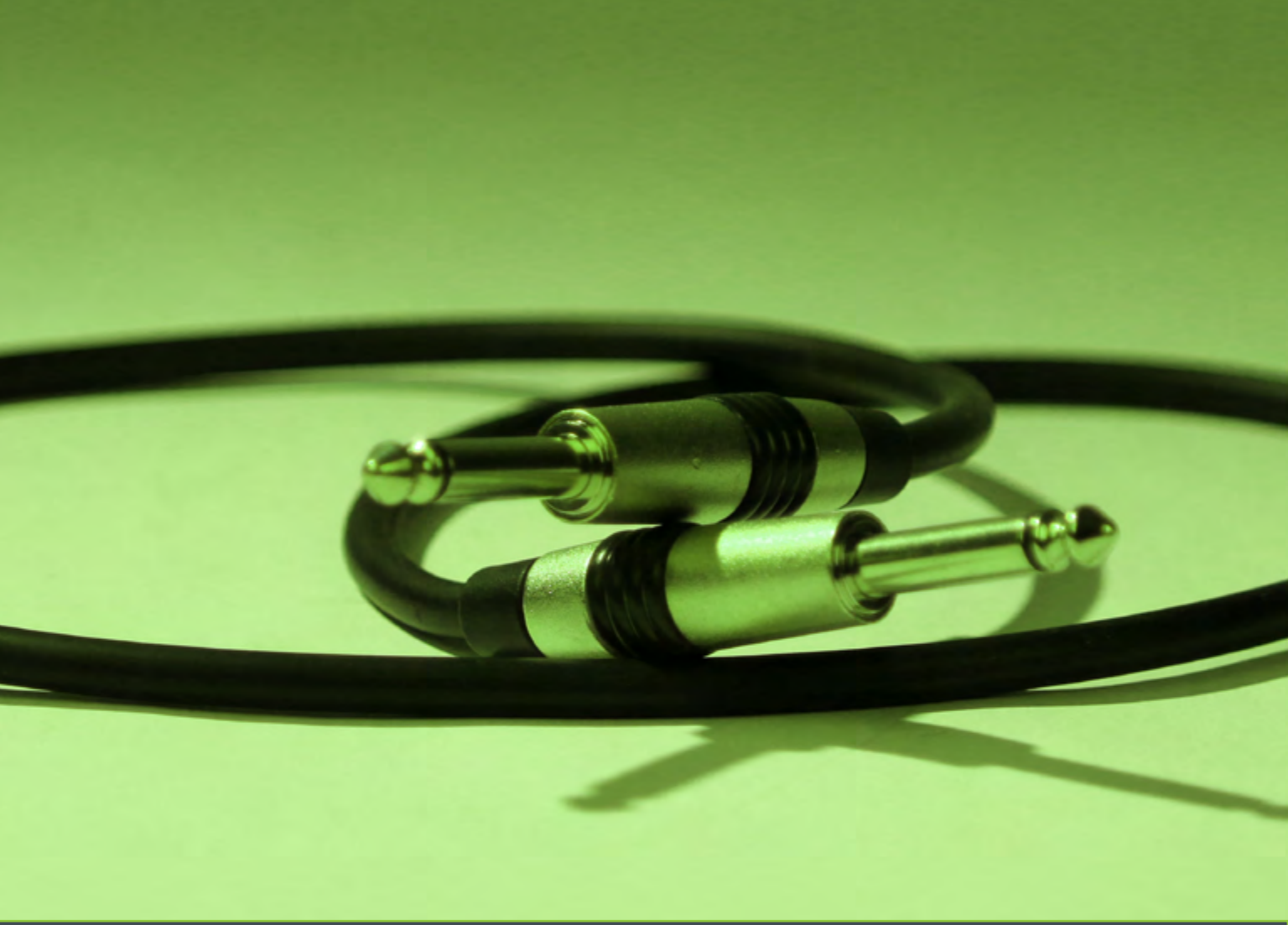
The most common reason to have a DI is as a backup should your amp or combo fail. The DI converts the high impedance output of your instrument to a low impedance balanced line for direct connection to a board when things go wrong.

A DI uses an Isolation Transformer to create a floating transformer-isolated output. This eliminates ground loops between equipment connected with unbalanced lines and provides the same noise-reduction benefits.

All passive direct boxes should have a ground lift to deal with hum and signal attenuation to deal with distortion. Remember to never place your DI on top of amplifiers or next to power supplies. The nature of a transformer makes it susceptible to magnetic fields produced by the power supplies from other equipment and will largely negate the DI's isolation properties.

Encore
Cables only change your sound if they are going bad, poorly constructed or are designed to lose some of the signal on purpose. High-capacitance cables are a design decision by some high-end manufacturers, and frankly, your ears might like them. No matter if you like flat and uncolored, or a high-capacitance cable sound with higher frequencies attenuated, remember if that "special" cable goes bad at a gig and you developed your tone around it, you better have the same cable as back up.

That low capacitance cable that someone is going to throw you from the back, so you can keep playing, is not going to shape the signal, and you are going to "lose" your tone. If you use low capacitance cables, your tone relies on what you "dialed" in. The truth is you probably could probably find the same tone with an amp using a quality uncolored cable. You then would have a repeatable process when things go wrong and would have saved money on your cables. A passive DI box is an inexpensive yet valuable addition to your rig since it will allow you to keep playing by plugging directly into the board should your amp or combo go down.



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