MY GOAL: -
To bring great sounding cables and "Tweaks" to the DIY Audio Enthusiast :-)

PLEASE NOTE: -
I have NO affiliation to the products or companies mentioned on these pages

The products mentioned are those that I have used over time and found to perform very well.

For links to products mentioned in the text see **Product Links* below

GOT QUESTIONS?
-
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Click on each menu item below to see the complete topic

So What's Here..

- * Cable Science Basics
- *You Need Good Power Cords

- November 2013
- October 2013
- September 2013
- August 2013
- July 2013
- June 2013
- May 2013
- April 2013
- March 2013
- February 2013
- January 2013
- December 2012
- November 2012
- October 2012
- September 2012
- August 2012
- July 2012
- June 2012
- May 2012
- April 2012
- March 2012
- February 2012
- January 2012

Discussion Power Cable Tweaks

RSS Feed

"Cable Science" - Some Basics

01/11/13 15:26 *HELIX USB Cable * Cable Science Basics

Will better quality cables improve the sound of my system?

The short answer is YES! But the caveats are many.

This year I've had a chance to investigate the world of conductor materials used in cables and connectors and have combined this with my prior discoveries to come up with hopefully a single post that will provide insight into my own journey of "Cable Enlightenment".

However, the following is just the tip of the iceberg, since I do not venture into the world of exotic cables that contain metals like gold, tungsten, or platinum, since I believe Silver to be the best possible choice for the conduction of electrical signals.

Let's talk generally about the various materials available...

First - let's get the easiest one out of the way

- SILVER is the best conductor
- COPPER is the next best
- The high quality OFC and OCC copper is significantly better than plain pure copper, but still does quite not match silver for conductivity
- the performance of other metals will fall far behind these two.

What about tarnishing?

- Tarnishing on copper severely impedes its ability to conduct electrical signals
- Tarnished silver on the other hand is still very conductive and barely affects its ability to conduct electrical current
- So why aren't there more silver plated products - I really do not know — but it appears more are coming

One "standard" used to gauge conductivity is the International Annealed Copper Standard (IACS) conductivity index — which uses tough pitch copper as it,s benchmark and rated at 100%

Here are the metals most commonly used in hi-fi and their conductivity ratings

- Silver - 105%-108% depending on purity
- Copper - 100% - 102% depending on differing types e.g. Oxygen Free Copper (OFC) and Ohno Continuos Cast (OCC)
- Gold - 76%
- Rhodium - 39%
- Brass 0 27%
- Platinum - 16%

The trouble with pure copper is it is very soft and difficult to machine — so very often a copper alloy is used

- For details on the various copper alloys used please see this document - IACS Conductivity Ratings PDF

Now, you may have heard that silver cables are "bright or harsh sounding" and copper cables are "warmer sounding"

- this may actually be due to other materials and constructions techniques used in the actual design of the cable, such as the insulation materials used, which can seriously effect a cables capacitance.
- High capacitance cables can cause a variety of effects, even the electrical operation of the components it is attached too, ultimately affecting the sound
- Also, if you do experience brightness, it might just be one of your components, so don't automatically attribute it to the cable.

Personally, I found my low capacitance Stager Silver Solids Interconnects to be excellent performers — detailed? EXTREMELY - bright? NO!

Now, if you prefer to use copper (many do), then high quality OFC copper and OCC copper are an excellent choice.

A word about connectors:

Connectors (i.e., RCA, IEC and Mains) are generally more of an issue than people realize.

- To start with, most are made of some kind of brass and then gold plated.
- Better quality connectors can be a high copper content alloy and often come with gold or rhodium plating.
- This combination is better than brass, but still far below the abilities of pure copper.
- Pure copper is seldom used since it is quite soft and difficult to machine, but they can be found and are generally more expensive.

Silver Connectors are the best, but for anything larger than an RCA, XLR or DIN connector, solid silver gets very expensive.

For all connectors pure copper is very good and a more cost effective alternative to silver, however…

- you may find that over a period of time they will tarnish and require cleaning
- the time period between cleaning depends on the humidity of your location

In order to prevent tarnish, a protective plating may be applied…

- if you can find silver plated copper, they will perform almost as well as solid silver.
- less effective plating metals are Gold or Rhodium, since they often require an intermediate plating material which is generally less conductive than either gold or rhodium
- Having said that, gold and rhodium plated products from companies like Oyaide and Furutech perform extremely well due to the excellent design and copper quality used in their construction.

A word about wire types:

What about Silver Coated/Plated cables?

- the verdict is still out on this one, but they are widely used
- I have them in my system and their performance is excellent,
- but I cannot offer an opinion as to their effectiveness since I have never compared them to plain copper of a similar quality
- the cables I have, are just very well made, which I believe is the main reason for their excellent performance.

What about Solid vs. Stranded wire?

- a solid wire has greater current carrying capacity than a stranded wire of the same gauge
- in my tests, the solid wire always provides better performance
- Solid wire CANNOT take a lot of repeated tight bending - it will fracture
- Most cables in my audio system are NOT subject to repeated flexing or bending, so this is NOT and issue

What about the type of insulation on the wire - cotton, Teflon, PVC, which one?

- the type of insulation affects the capacitance of the wire
- to assess this, there is a measurement called Dielectric Constant - or Dk.
- A Vacuum is 1.0 and Air is under 1.1 but these are generally not easy to implement
- Cotton & silk are around 1.3,
- Foamed Teflon just less than 1.45
- and Teflon is around 2,1

How does the insulation affect cable performance?

- Think of a wire as a capacitor and the insulation is its dielectric material
- as the signal changes polarity so does the charge in the insulation
- As the charge changes, noise is introduced into the wire
- An insulation with a low Dielectric Constant results in less noise

So that covers the material selection for good cables and connectors.

Let's talk about cable choice and construction approaches...

For My Interconnect cables...

- I use a non-conventional DIY cable where the neutral cable is wrapped around the signal wire in a helix. Pretty simple, but extremely effective. See ** The HELIX IMAGE Interconnect (1)
- see ** The HELIX IMAGE Interconnect (1)

For My Speaker Cables

- I currently use a cable geometry similar to my DIY interconnect, where the neutral conductor is wound in a helix around the SIGNAL Conductor
- This architecture provides the fastest dynamic response of any power cable I have tried to date and is extremely "black" i.e. no noise.

• See *HELIX IMAGE Speaker Cable (1)

For My Power Cables

- I currently use a cable geometry similar to my DIY interconnect, where the ground and neutral conductors are wound in a helix around the Live Conductor
- This architecture provides the fastest dynamic response of any power cable I have tried to date and is extremely "black" i.e. no noise.
- see **The HELIX IMAGE Power Cable (1)

Making the Connection: Which is best - Crimp, Screw or solder connections?

For Interconnect cable the choice is very limited — solder is the de facto standard, but there are some cable manufacturers that provide crimped terminations

- If you are constructing the cable then you will probably solder, be sure to select one of the hi-fi grade solders — see IACS Conductivity Ratings PDF

For IEC and Mains connectors, the de facto standard is a screw clamp connection.

However a recent endeavour to create a mains cable from Furutech 10 gauge cable led me to crimp copper spades to the cable prior to clamping the cable in place. The resulting performance led me to adopt this technique for all power cables. I can only attribute their superior performance to the fact that the crimping created a very good cold weld, with the spade increasing the surface area in the final screw clamp connection.

For speaker cable I prefer banana plugs.

The reason for my preference of Banana plugs over spade connectors is because they provide the largest contact area for the style of binding post I have on my speakers and I only have banana connectors on my amp.

It's not just the cables — my "special connectors" are a key component:

What do I mean by special connectors?

They are special due to either their design and/or use of high quality copper or Silver and the ones I currently have in use include:

KLE Innovations Pure®Harmony RCA and Absolute®Harmony RCA Connectors...

- These RCA connectors that take a different design approach
- basically, instead of a large metal collar to make the neutral connection, the collar is made of a polymer with a small metal pin to make the contact
- having high quality copper/silver contacts also contribute greatly to their superior performance.
- After installing these on my Stager Silver Solids interconnects the improvements in the spatial image, details and dynamics, were very apparent.
- seems their design approach works very well, resulting in significant improvements to micro details, instrument isolation and depth of the 3D image.
- see my reviews of the entire KLEI Harmony RCA plug range in the menu on the left side of this page for details

Sonar Quest Silver Plated Copper IEC and Mains connectors

- I discovered these while searching for a silver plated copper connector and for the price I ordered a set for evaluation
- They provide appreciable improvements in details, dynamics and space and the price was right
- They are outstanding performers compared to many others on the market, even name brands and now have replaced all of the mains connectors throughout my system.

KLE Innovations Classic Banana Connectors

- By far the most precise fitting and detailed banana plug on the market today
- They convey the most subtle details with recision

All of these connectors have made a significant contribution to the improvement of my system performance and I consider them a very important ***"component"***.

A word about quality

Here's my favourite question I've been asked a few times **"I found this brand name cable on the web — it's a steal — what do you think?"**

Bottom Line: If it's a steal, YOU are probably not the one benefitting out of the deal!

- We live in a world of counterfeit product — the general rule is "if it sounds too good to be true — it generally is"
- I have seen cable that revealed extreme corrosion once I stripped the insulation away from the middle of a 20ft length
- The type of corrosion (including rust) also indicated the quality of the copper was of a very poor quality
- Even "established brands" cannot always be trusted - I've had brand name cable where the insulation degraded over time, leaving a sticky residue — the insulation was transparent and you could easily see the entire cable was tarnished
- But, I also have cables where after 16 years of use, stripping the insulation reveals a bright shiny new conductor with no sign of tarnish.
- So it's not just the quality of the conductor but the insulation also.

So, how do cables and connectors contribute to better sound in a nutshell?

For interconnects: it's all about the transfer of delicate low voltage signals, which is impacted by the conductivity of the materials used in the cable and the connector and the design of the cable and connector also appears to contribute immensely.

- Low capacitance cable is essential to avoid any "alterations" to the delicate signals — e.g. it is well known that high capacitance phono cables can seriously degrade cartridge performance
- Silver, followed by OCC and OFC copper should be the material of choice for the conductor.
- Solid Silver, silver plated copper, or plain copper should only be used for the connector
- For RCA connectors, I prefer the KLE Innovations Harmony Plug RCA products, as they contribute significantly to a very detailed and dynamic performance
- Cable architecture is a key to reducing the amount of noise that is created within the cable itself
- - see "The HELIX IMAGE" - With a little help from my friends

For speaker cables: the quality of the conductor and connectors is always paramount.

- low capacitance cable can be essential for some amplifiers, as a high capacitance cable can cause the amplifier to oscillate, which will severely degrade the sound. But the converse is also thought to be true for other amps, so you have to know the impedance loading requirements of your amp
- A silver cable is an option these days, but I've found the ones I have auditioned (consisting of a very small gauge conductor) lack bass, but are very detailed
- Larger gauge silver cables are available but are of course very expensive
- At present my personal preference is my own DIY Speaker Cables - The HELIX Speaker
-

For power cables: based on what have tried, the quality of the connectors and cable geometry appears to be paramount and the cable quality a little less so, but there is a definite correlation between the gauge of the conductor and the component the conductor is connected too.

- For amplifiers a larger gauge cable is required, but for components a lighter gauge can be used.
- **What about cable quality?** - I have tried making braided power cables from 10 and 12 gauge Romex (i.e. standard house wiring cable) and to my surprise they performed extremely well, but they were a little stiff and not recommended
- Did they perform better than my Furutech or DH Labs power cables — well, not quite, but they did perform so much better than any stock cable provided with a component I have ever purchased.
- My latest design DIY Power Cables - The "POWER HELIX" using a helix wrapped architecture which appears to outperform most other power cable designs.
- The improvements include much faster dynamic presentation, a significantly wider image and improved clarity.
- **What about connectors?** - I found that the Sonar Quest silver plated IEC and mains connectors to perform better than any gold or rhodium plated copper connectors I have used so far.
- **What about termination?** I found that crimping small copper spades to the cable instead of just clamping down on the bare wire within the connector provided significantly better dynamics, bass and details
-

What about the mains power outlets? — For these I currently use Pass and Seymour MRI power outlets, which are good quality outlets that are reasonably priced, but their advantage over the standard household outlet is their ability to clamp the mains plug like a vice and the MRI rating ensures a higher level of materials quality.

I also installed a dedicated 15 amp Outlet just for my audio system — this helps eliminate any noise created by other household appliances that might otherwise be on the same circuit

Why do Power Cables make a difference? please read Why Good Power Cords Make A Difference for a detailed explanation

So, back to the original question: Will upgrading cables improve system performance?

The biggest impact to my system performance was due to upgrades I made to my entire "POWER CORRIDOR" - what is that?

- Starts with a dedicated 15 amp power line from the breaker panel with good quality wall outlet, but standard 15 amp Romex house wire
- My amp is connected directly to the wall outlet, but my source components are plugged into a Power Distribution Centre
- My Power Distribution Centre is a DIY project that contains three quality dual outlets and quality internal wiring - no filters, no surge suppressors
- All my power cables are Custom DIY projects, with Sonar Quest silver plated copper IEC/Mains connectors and an unconventional architecture where the Ground and Neutral conductors are wound around the live conductor in a helix, which results in extremely clean power delivery.
- Without these, all other improvements realized by upgrading any other cables would have been far less noticeable.

Why upgrade the "power corridor"? - if an active component (i.e. one that requires power to function) cannot get sufficient clean power in an instant the internal voltages fluctuate. This in turn introduces distortion or smearing into the audio signal which finally gets amplified to audible levels.

The helix geometry also reduces/eliminates noise induced into the neutral conductor, which ultimately effects component performance.

The caveat here is — use a good speaker cable to start with. Then you will be more able to hear differences that other cables choices may bring

FINALLY:

Most of the products I have used were constructed or installed by myself, so finding similar components in ready made products is highly unlikely, but not impossible.

As I said at the beginning of this post, this page is just the "tip of the ice-burg". More "high end" audio systems may well require some of the more "exotic products" currently available to achieve improvements, but the basics still apply.

Research products first to ensure they use the best quality materials and construction techniques before you buy. Don't blindly believe the company blurb or sales guy.

If purchasing ready made product, ensure the store will refund all your money if you are not satisfied, or better still, find a store that will support in-home auditions. Many stores selling high-end systems will be more than happy to demo product at home because they are confident in their product.

Well - that's about the sum of my findings - I hope you found it useful

And be sure to checkout the following related topics on this blog...

You Need a Good Power Supply (1)
*Product Links (1)

Tags: Tweaks