Antenna Wires – Which Is Better?
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Are we really using the optimum wires for our beverage, longwire and air core loop antennas? The question has matured over some time, so we may ask questions about the conventional wisdom concerning antenna wires, includion the following; Is copper really better than iron, steel or aluminum? And do we really need PVC coating (insulation) of the wire? If so, for what? I have seen statements in DX magazines and on the net strongly advising against non-copper antenna wire and uninsulated wire, but these recommendations seem more based on prejudice than fact, see www.w8ji.com on the subject of insulation or not.

Ever since I began to erect "proper" antennas, I have used insulated copper wire, usually 1.5 mm^2 (somewhere between AWG14 and AWG15). Not because 1.5 mm^2 was necessarily perfect for the job, but because it made a good compromise between strength, weight and price. Smaller wires (such as 0.75 mm^2) tend to break easily, while thicker wires (such as 2.5 mm^2) are heavy and need more supports to avoid sag. Copper is rather expensive. You can find good prices, especially if you know somebody in the production or distribution line, but in general it is difficult to find 1.5 mm^2 insulated wire in 100-meter rolls for less than €0.20 per meter. 2.5 mm^2 is usually 50% more expensive.

My goal was to find out if copper is superior to other metals for signal levels and for signal to noise ratios, and if insulation is necessary.

Metals to consider
Apart from insulated copper, I have found two other candidates for antenna wire, both abundant on electric fence systems: Galvanised steel and aluminum.

Galvanised Steel
The wire I found consisted of seven leads wrapped around a plastic core, resembling ordinary copper wire (sans the plastic core). Steel rusts. Stainless steel rusts too, just not quite as fast. Zinc galvanisation prevents the steel from oxidising (and thus, rusting). There are several grades of galvanisation. If you live in a demanding climate with frequent changes between freezing and thaw, high air humidity, high air salinity and so on (such as I do), you should not compromise on the protection of the wire.

Aluminum
This is not a wire, but a string. As most people will know, aluminum does not rust the way iron and steel do. The surface will oxidise and protect the inner parts from further deterioration.

Which makes a better antenna?
There was only one way to find out. Put insulated copper, galvanised steel and aluminum side by side and see which heard best. Of course, when erecting an antenna, conductivity itself (where copper excels) is only one of several considerations you must make. Sometimes, weight is an issue. Sometimes, supports, or lack of supports, when erecting a beverage is an issue which makes strength an issue. Visibility may be an issue. Flexibility (the "smoothness" of the wire) may be an issue. Price may be an issue – especially when considering a beverage array with several long beverages.

Which is the best ear?
I tested insulated copper, galvanised steel and aluminum of comparable thickness in A-B tests using

beverage-on-grounds (BOGs) of 140 meters and 300 meters. I compared signal levels on MW, and on 15 Mhz. The short version of many measurements is this: Galvanised steel and aluminum seemed to have almost identical signal pick-up. Insulated copper always came up on top, however by a very small margin. 140 meter BOG, MW: Less than 3dB difference. 300 meter BOG, MW: Less than 5dB difference. 140 meter BOG, 15 Mhz: Around 5dB difference. I am inclined to assume that the difference is proportional with length, and with frequency. My very unscientific guess is that if you are putting up a normal longwire, or a large air core loop, you will not hear any difference in signal levels.

Which is less noisy?
Many people believe that the insulation around the copper wires prevents weather-induced static noise. It doesn't. My insulated copper beverages will hear S9+20 noise during blowing snow conditions (like gale force winds and snowfall, or gale force winds and new fallen snow). I shouldn't have these noise levels if the insulation was working. When I compared the three wires in gale force wind and heavy rainfall, there was no difference at all in noise levels. I have put up a steel wire beverage at 1-m height on the beach right through a "forest" of >1 meter Sand wild rye which are in constant movement. There is no noise from this physical contact.

Which is more flexible?
Insulated copper, without a shadow of doubt. If this is important for you, steel or aluminum should not be chosen. The smooth PVC surface makes less friction on support rods if you are erecting a supported beverage. But there are work arounds. I use electric fence PVC insulators on top of my supports. They are smooth, and allow steel or aluminum wires to run free.

Which is stronger?
Steel, by a comfortable margin. Aluminum is very strong as well, insulated copper a distant third. If you are erecting a supported beverage and the distance between support rods are long, you can put a lot more tension on the non-copper metals to minimise sag. In addition, steel and aluminum stretches very little. Copper stretches a lot, often requiering re-tightening of beverages or air core loops.

Which is lighter?
For comparable sizes, aluminum. It is extremely lightweight and would be an excellent alternative if you have long runs between the support rods. Steel is also much lighter than copper – of course with copper being a heavier metal by itself the PVC coating adds a little weight too. Also there is less wind in steel and aluminum (again for comparable sizes) since the PVC adds area. When your beverage is up against a gale force sidewind, you will see that this really matters.

Which is stealthier?
Visibility may be an issue. Sometimes, you would want an antenna to be seen (so that people don't run into it by accident). Sometimes, you would want it to be as invisible as possible (so that you don't irritate your neighbours with your large garden air core loop). Although the PVC-coated copper wires come in many different colours that can match your requirements for visibility, I find the steel wire to be the one with the best stealth factor.

Which is cheaper?
The prices I have found here in Norway indicate that for comparable sizes, aluminum is the cheapest and insulated copper the most expensive.

Which is best durability?
Ah – the jury is still out on this one. The PVC insulation prevents the copper from oxidising. This should ensure excellent long-term performance. I simply don't know if the metals used in electric fences will last as long – with steel the problem will be with the quality of the galvanisation. If at

some point it wears off, you will probably have to replace it. Aluminum should be a long-term performer. Just look at the Yagis that the radio amateurs use.

Conclusions:

- For most practical purposes, galvanised steel and aluminum are excellent antenna material. The difference in gain will only matter in very low-noise environments and for very long antenna runs. For short beverages and longwires, I am fairly sure that there is no practical difference in antenna gain.
- I assume – although it is as yet untested – that the same will apply for large air core loops like the K9AY, and for EWE's.
- If strength or weight is an issue, then galvanised steel or aluminum are the materials to be chosen. On the other hand, if flexibility and antenna gain is an issue, then insulated copper wire is the better choice.
- The PVC insulation usually found on copper wires will NOT protect against weather-generated static noise. It may protect the leads better in the long run, but for steel, the quality of the galvanisation is probably the most important factor for long life.