

# The Radio Hotel – The Skinny on Wire

By Rick Hiller -- W5RH

One thing all antennas have in common is that they have some type of radiating element made of some type of metal. It's formed into wire or tubing or solid rod, but it is metal. Hopefully, a low resistance, highly conductive, reasonably priced metal. For conductivity, gold is best, then silver, but then the antennas cost many more times that of the whole ham shack. So, copper in its' various forms, or aluminum, are the chosen metals for antenna work as they have conductivity ratings that are quite good. Yes, there is also galvanized fence wire or steel wire, but both of these fall at the bottom end of the useable spectrum of available metal, as you will see below.

In any RF engineering or Amateur Radio publication dealing with antennas, there is typically a chapter on materials. Some of the legacy engineering books limit their discussion to wire (as Yagi-Uda's were yet to be made practical using tubing). The [ARRL Antenna Handbook](#), [Low Band DXing](#) -- Devoldere, [Antennas – Kraus](#), or [Radio Engineering—Terman](#) are a few good examples of books to educate yourself no matter what level of study you wish to achieve – practical to text book. They all have charts and equations for figuring out weight and strength and resistivity and conductivity, etc. This is all well and good and worth a read in your spare time, but what we really want is a concise, fairly brief, well written document to tell us exactly what we want to know, which is “**what wire is best to use for building my dipole ?**”. In order to answer this question, we need to first figure out just what is required from the wire/material that we wish to use. It needs to be strong, easy to work with, conductive, low resistance, easily obtainable, reasonably priced, resistant to weather and other outdoor elements and long lasting, as you don't want to rebuild your antenna every year.

Most of the simple antennas like dipoles or loops at 3.5 MHz (80 meters) and higher can be made with any form of copper or aluminum wire. These antennas are short and consist of a single half wavelength or a full wavelength of wire, at most. Unless the resistive losses are large, as in fence wire, any copper or aluminum wire type will do just fine. However, when you get down to the lower frequencies like 160 with a half wave dipole length of 240 feet or you start building arrays of multiple elements with associated feed impedances dipping well below 50 ohms, wire loss starts to affect the available gain of the array. Krause's W8JK Array is one such beast and Krause detailed this phenomena back in 1940.

Cutting to the chase (finally), N6LF, Rudy Severns, investigated this area of wire material and outlined his findings in a paper “Conductors for HF Antennas” (just Google the title to find the PDF). It is an excellent treatise concerning wire and conductive material not only from a 'new' material standpoint, but it continues into weathered conductors and the degradation oxidation causes the resistivity, etc. His first chart shows Conductivity (Siemens per meter) versus Resistivity (ohms per cm) for Silver, Copper, Aluminum, Iron, and Stainless steel. Let me say here that Rudy adamantly suggests that you stay away from iron and stainless steel. Their numbers are 5 to 10 times worse.

He also delves into the characteristic of wire size....the bigger the diameter the larger the outer surface area (think RF – skin effect) and also into flat strip conductors (like copper grounding strap). In the end, the winners were as follows, #12 soft drawn copper wires both insulated and bare. # 12 stranded THHN, 7/22stranded copper and #8 aluminum fence wires were up there too. But, you put a little oxidation into play and the “uninsulated” soft drawn copper, both solid and stranded, take a dive and become quite lossy. Insulation saves the day, in the long run, although it does affect the velocity factor/resonance a tad. But that is easy to contend with when calculating, building and tuning the skyhook of your choice.

So, taking all characteristics, attributes and requirements into account, Rudy's leading recommendation for wire type, no matter what the length or frequency, is **insulated, #12 solid copper**.

Enjoy your hobby. GL ES 73 DE W5RH

## Next time.... Antennas That You've Never Heard Of (probably)

*The purpose of **The Radio Hotel** is to give you a practical kickstart into exploring the workings of antenna systems. Google the buzz words and find out what they mean. Read up on antenna system theory to see how it all works together. You will be glad you did.*