

## White Bronze Plating

### Introduction

The necessity of White Bronze plating for use on RF connectors gained popularity in the early 1990's as cellular telephone communications and networks were taking form. A short description as well as advantages over other platings will be discussed in this article but first, a brief on the history of White Bronze.

From the 1870s through the 1910s, white bronze was used as a raw material for grave markers by certain manufacturers. This type was mostly zinc, rather than tin alloy mostly used in jewelry. It was called white bronze as a marketing ploy to make it sound more attractive. Grave markers made of this material usually took on a pale gray or pale blue appearance and stood up to the elements better than stone markers because they were less porous. These grave markers were actually hollow and consisted of vertical panels held together by screws at the corners. It is said that outlaws sometimes took advantage of this fact and hid stolen goods inside the tall hollow monuments. White bronze is actually not bronze, but an alloy of varying amounts of copper, tin and zinc. It is commonly used in jewelry as a substitute for nickel.<sup>1</sup>

White Bronze plating for RF connectors offers many advantages over Nickel or Silver plated connectors. Improved electrical and intermodulation performance, better wear characteristics in harsh conditions and low insertion loss compared to Nickel are just a few. Although Silver has been the preferred finish with outstanding electrical characteristics, it pales in comparison to white bronze mostly due to the corrosive and the tarnish effects of Silver oxide.

### Composition

White Bronze is composed of Copper, Tin and Zinc. The deposited amounts of each vary in the order of about 55-60% Copper, 20-25% Tin and 15-20% Zinc. The end result is an aesthetic finish similar to stainless steel.

## **Advantages of White Bronze**

- Low intermodulation products (more on IMD and IMP in another article)<sup>2</sup>
- High corrosion resistance
- Low porosity
- Low RF losses
- Non magnetic
- Wear and scratch resistant

When exposed to harsh environments, white bronze retains its aesthetic appearance. Unlike Silver, it won't discolor when exposed to sulphur, potassium sulphides or similar corrosive chemicals. No oxide build-up occurs in white bronze as in Nickel which can be found between its' deposited layers. Contact resistance remains unchanged when exposed to high temperatures greater than 100°C. Also, measured results did not vary at high humidity levels.<sup>3</sup>

Plating's with non-magnetic properties used on non-magnetic base materials are highly desired in medical applications such as MRI and CT scanning equipment. Hysteresis in electromagnetic environments is another concern in RF transmission. Electrical lengths change with temperature and other factors so the use of White Bronze further galvanizes these effects.

Rapid changes in temperature can cause plating to blister or crack. White Bronze won't succumb to either of these due to its coefficient of thermal expansion being nearly identical to brass. Brass is predominantly used in the construction of RF connectors.

Resistivity loss due to the skin depth effect is minimized by the low porosity of white bronze further reducing insertion loss at higher RF frequencies.

Substantially higher wear and scratch resistant, the hardness of white bronze is double that of silver. Again, another desired feature allowing for prolonged mateability compared to silver plated connectors.

The electrical properties of White Bronze are similar to the properties of Silver. A full discussion can be found in our article entitled "Intermodulation distortion in RF connectors"

## **Conclusion**

White Bronze offers a high quality surface plating with excellent intermodulation performance when used on RF connectors in high power applications. With the many advantages over Nickel, Stainless Steel and Silver, it definitely was a good fit for our company and motivated our Engineering group to begin including it. It's been widely used by RF and microwave communications manufacturers for 20 years now. RF will be introducing more White Bronze connectors and adapters.

<sup>1</sup> Source: Excerpted from wiseGEEK, author Adam Hill

<sup>2</sup> Full article titled "Intermodulation distortion in RF connectors"

<sup>3</sup> Source: Testing performed by M/A-COM to US Mil, European and IEC standards