

Material Facts To Consider When Considering Contacts

By: Deb Bievenour, Field Sales Engineer, Heilind Electronics

A while back a customer I'd sourced consumer appliances components for needed a connector for a hammer drill application. Its appliances used connectors with brass contacts but for this application the customer needed a different material. Mainly because the tool used a receptacle and tab-type connection and – with brass contacts – the vibration and heat build-up inherent in the operation of a hammer drill could cause the receptacle to come loose. Importantly, the design team needed a contact and a contact material capable of keeping normal force against the tab during usage.

The solution was to use phosphor-bronze contacts. Given the hammer drill's more rugged operating environment and the need to guard against an increase in the failure rate, it was easy to justify the added expense of the upgrade.

In the remainder of this post, I will briefly discuss the three most common materials used for electrical contacts and when to consider one over the other.

The 3 most common materials used for contacts and how they can affect your choice:

1. **Brass** – According to *TE Connectivity*, brass is arguably the most common material for contacts. It's easy to understand why. Brass contacts offer cost benefits, excellent conductivity and dependable electrical and mechanical performance. Prevalent in most appliances and consumer electronics, brass is the contact material of choice for HVAC, lighting, personal computing and many similar applications.

If your application will be operated in a controlled environment such as the home, an office building, a casino or the like...if the application isn't going to be running in a high temperature setting...and if it's not a mission-critical signal that needs to be read through the wire...then brass contacts will usually serve you well. They'll also give you the best value for your money. Brass does have environmental corrosion issues though. So if you expect your application to be operated outside of a controlled environment you'll want to make sure your contacts are properly plated.

2. **Phosphor-bronze** – Often referred to in industry lingo as *phos-bronze* this widely used contact material, to quote Wikipedia, "is an alloy of copper with 3.5 to 10% of tin and a significant phosphorus content of up to 1%. The phosphorus is added as a deoxidizing agent during melting."

As the operating environments and performance requirements become harsher and more demanding you'll want to give strong consideration to phos-bronze contacts. For example, in an application that's continually running at a high temperature brass contacts will, in short order, start to break down and lose their spring properties.

Phos-bronze contacts, on the other hand, generally perform well in extended high-temperature environments. In addition, phos-bronze maintains very good long-term spring properties, making it an apt choice for smaller contacts. Phos-bronze is typically the material of choice for contacts used in moderate-power connectors and small and medium-pitch signal connectors. In summary, phos-bronze is a good, middle-ground material choice, ideal for when you need to meet the challenges of a more rugged operating environment without busting your budget.

3. **Beryllium copper** – To borrow an expression that was more apropos in my grandparents' day, beryllium copper "is the Cadillac of contact materials." Quoting again from Wikipedia, beryllium copper "is a copper alloy with 0.5 – 3% beryllium and sometimes with other alloying elements. Beryllium copper combines high strength with non-magnetic and non-sparking qualities."

Compared to brass and phosphor-bronze, beryllium copper has superior spring properties and comes in the smallest size and lightest weight. It's also the strongest material of the three and – by far – the most expensive. Not surprisingly, given the factors just cited, beryllium copper is the contact material of choice for most telecom, military and aerospace applications.

In general, the smaller your contact is, the greater the stress will be and therefore the greater need you will have to use beryllium copper for your contact material.

The last word

When choosing a contact material it really does depend on what your end product is and what the circumstances are. Do you really need to have phos-bronze contacts in a washing machine? No. But do you want to use a brass contact on a space rocket? Of course not. In short, your choice of contact material depends on how critical the application's performance is to the operation of the end product.