

## Contact Material Choices

When designing a switch into an application the engineer must determine what type of contact material is necessary for optimum performance of the switch. There are a number of materials to choose from, this article will look at the three most common types of contact materials:

- Silver
- Gold
- The third most used is a combination for the first two, gold over silver.

In order to obtain the best performing contact, silver is the material that is most commonly chosen. What makes silver the best performance choice is its chemical, electrical, thermal, mechanical properties and low cost. When silver contacts are contaminant free and clean, there is no lower limit to what voltage or current can be used and that can be controlled reliably. Silver contacts also have a very low contact resistance, thus allowing the contact switching to be more reliable in industrial-pollutant free environments. Unfortunately, silver does tarnish easily when moisture and airborne acids are present. The tarnish is a hard, insulative and oxide layer that will form on a silver's surface. In rare instances the tarnish may affect the performance of the switch, but with mechanical forces and the movement of the contacts, along with the circuit voltage, the tarnish film that is insulating the contact can be vaporized in order to establish good electrical contact. In circuits where an arc is expected, which is above 0.5A @11.0VDC, the tarnish can be broken through.

Gold contact material should be used in low level, or dry circuit applications. The maximum rating for gold is 0.4VA @ 20V AC or DC. Gold will not tarnish as easily when exposed to moisture and airborne acids thereby making it a good solution for low current and voltage applications. Gold does have some important limitations as a contact material. Gold is expensive. It is also very soft, ductile, and pliable. If gold plating is used in an application where an arc is expected, the gold will literally melt off of the contacts. The base material will leach through the porous thin gold layer to the surface. When this happens, corrosion and oxidation of the base material will take place and the contact resistance will rise to unacceptable levels.

In order to obtain some of the advantages that of both materials, gold plating over silver is an option that is used sometimes in the industry. One example where gold over silver is useful is in a double pole switch where one pole is switching the power circuit and the other pole is switching the logic level. Another advantage of gold over silver contacts is that some OEM's may prefer to stock only one switch for both the power and logic circuits. In this case, if a gold over silver contact switch is placed in a power circuit, the gold will soon be vaporized off leaving only the silver material to handle the power switching. In the logic circuit the gold will remain intact because of the low energy switching and it will provide tarnish free contacts for high reliable switching far into the future. The biggest drawback to this contact material is its high cost.

Therefore when designing a circuit which utilizes a switch, choosing the proper contact material must also be considered, from the understanding of the circuit (voltage, current, life, etc) and environmental (moisture, humidity, etc) conditions, to the overall cost. The industry has developed a variety of solutions to support each of these requirements and needs.