Silver Plating Thickness

September 21, 2021

Corrosion of an electrical connection can be a serious concern for equipment users. The reduction in conductivity caused by oxidation of contact surfaces can cause higher operating temperatures. The bus found in indoor switchgear can be aluminum, but is most often copper. Both materials oxidize very quickly when exposed to certain environmental conditions so they are typically plated with silver or tin when used in switchgear. Silver is the harder of the two materials and is better suited for applications where the contact points slide, such as the primary disconnecting devices between the circuit breaker and switchgear or any sliding current transfer point on the circuit breaker. The plating used on bus bars is only required at the connection points and may be silver or tin as required by the environment where the switchgear is applied.

Powell uses copper as the primary conductor for its circuit breakers and switchgear and chooses the plating for components based on the rationale discussed in Technical Brief PTB 41. Technical Brief PTB 135 discusses galvanic corrosion at bus joints with respect to dissimilar hardware material. Technical Brief 143 addresses silver tarnishing and proper cleaning. This Technical Brief will address the question of plating thickness.

Most government and insurance provider specifications require that all bolted bus connections be plated in accordance with applicable specifications. While it is not a requirement of the IEEE Standards for Switchgear, good industry practices recommend that all bus contacts be silver plated. Field experience and laboratory studies have shown that this is especially true in the case of bus bars and bolted high current connections. Specifically, silver plated bus bars outperform unplated bus bars by providing stable contact resistance and a low maximum operating temperature that increase the service life of the bus joint. More importantly, stable contact resistance joints will reduce the need for frequent maintenance, decrease overall downtime of equipment, and greatly reduce the risk of failures.

Testing and field experience has shown that surface plating with silver or tin can help minimize the effects of irregular mating surfaces and the formation of oxides and other surface films on joint performance. So how much do you need to gain these benefits?

One common argument for using thicker bus bar contact plating is that it can provide a “leveling effect” to increase the surface area of the bus joint. In other words, plating with a soft material such as silver or tin effectively forms a compressive gasket on the surfaces to be connected. The force applied when bolting the surfaces together squeezes the conductive material into the low areas, effectively increasing the contact area and decreasing the overall joint resistance. This is a very unlikely situation given the relatively large surface area of typical switchgear bus joints and the relatively small forces that can be applied by assembly hardware.

On the other hand, tests have demonstrated that these materials greatly slow down the formation of copper oxide and other surface films, maximizing conductivity and minimizing heat. A silver plated joint allows operation at a higher temperature without joint degradation over the life of the joint. The end result, over time, is significantly increased performance, efficiency, economy and reduced maintenance.

It takes very little plating to provide oxidation resistance. There are no minimum thickness requirements for bus plating stated in the IEEE Standards governing Switchgear. ASTM B700 may be offered as a plating guideline, however, this document is not referenced in the ANSI/IEEE Switchgear Standards and identifies requirements beyond those necessary for proper switchgear operation. While these additional

Powell Industries, Inc.
7232 Airport Blvd.
Houston, TX • 77061

Tel: 713.944.6900 • Fax: 713.947.4453
powellind.com
info@powellind.com

Silver Plating Thickness

requirements are not detrimental to switchgear performance, they significantly increase the cost of the bus plating while providing no additional performance enhancement.

The Switchgear Standards typically allow a 35°C increase in allowable thermal rise for silver, tin or equivalently plated joints over those of unplated bus . Therefore, the application of as little as 0.00001" to 0.00003" of silver (flash plating) can provide protection from oxidation and improve the thermal performance of copper.

Thicker applications may be required for wear resistance when using sliding components such as contact fingers, disconnecting devices, and switch blades, but care should be taken in selecting both the thickness and plating material. Softer materials such as tin may gall or bind in sliding applications, especially when applied in heavy deposits. It is also important to examine the melting point for the plating material as with respect to short-circuit heating. For example, the melting point of tin is about 4X less than the melting point of silver, so tin plating could easily melt or weld sliding contacts during short-circuit events.

Michael Wactor, P.E.
Technical Director – R&D

Powell Industries, Inc.
7232 Airport Blvd.
Houston, TX • 77061

Powered by Safety®

Tel: 713.944.6900 • Fax: 713.947.4453
powellind.com
info@powellind.com