

Plating Information Silver-Indium

Overview:

Parker Hannifin's Silver-Indium diffused plating is a patent-pending electro-deposited plating process developed for metal seals exposed to hot, oxidizing environments. This new coating is specifically engineered to minimize the blistering and subsequent delamination often seen with plain silver or silver-gold composite coatings.



Figure 1: Blisters seen on a standard silver plated seal after 1,000 hours in air at 500°F

Figure 2: Parker Hannifin's Silver-Indium diffused plating

Current Plating Technology:

Silver plating is typically used to improve the performance of static metal seals by providing a ductile, low-hardness outer layer capable of conforming to irregularities in the mating surfaces. However, silver is easily permeated by oxygen at elevated temperatures, leading to oxidation of the underlying substrate. This oxidation causes the silver plating to lose adhesion and blister. As a result, silver and silver gold composite coatings are generally limited to application temperatures less than 500°F.

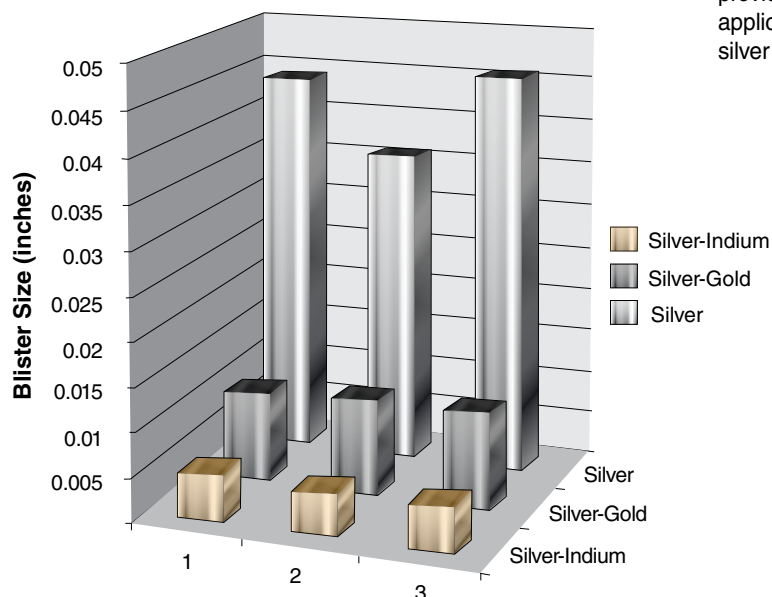


Figure 3: Blister size of Silver, Silver-Gold, and Silver-Indium samples after 500 hours in air at 1150°F.

One method used to combat silver blistering is to add a thin layer of gold between the substrate and the silver plate. The dense gold layer retards the diffusion of oxygen, thereby reducing the incidence of blisters. Although this method is highly effective, it is prohibitively expensive for general or high volume use.

The Parker Solution:

Parker's solution incorporates a unique heat treatment process to diffuse a thin layer of indium into the silver plating, producing a soft but robust surface that is more resistant to high temperature blistering than either silver or silver-gold composite coatings. The diffused indium prevents oxygen diffusion through the plating layer in two ways. First, the indium binds to oxygen at both the surface and within the plating matrix, forming stable oxides. Second, the indium fills inter-spatial voids within the silver plating, effectively blocking atomic diffusion of oxygen atoms, thereby preventing them from reaching the underlying substrate.

Performance:

Long-term testing confirms that Parker's new Silver-Indium diffused plating is significantly better at reducing blister formation and subsequent delamination when compared to plain silver or silver gold composite coatings. And, because Silver-Indium retains its ductility during and after high-temperature exposure, sealing performance is fully maintained.

Applications:

Silver-Indium plating is suitable for use in applications currently using plain silver or silver-gold composite coatings for enhanced sealing performance, including aerospace, automotive, and heavy diesel applications. In addition, the added oxidation resistance provided by Silver-Indium allows it to be used in high temperature applications (up to 1150°F) well beyond the capability of standard silver and silver gold composite coatings.