Next Best Thing to a Close Shave:
Mitigating the Risks of Tin Whiskers

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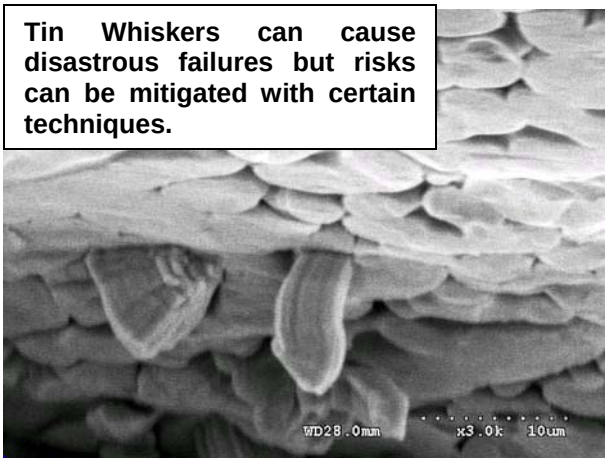
If you've been in electronics for any length of time, the phenomenon of tin whiskers is something you've likely heard discussed (maybe in scared whispered tones). Tin whiskers certainly aren't a new problem. In fact, some of the first published reports of the occurrence date back to the 1940's and 1950's. But, over half a century later, we're still talking about it.

The commercial world has transitioned to lead-free and, consequently, manufacturers that produce high-reliability products (military, etc.) are stuck with components that have tin terminations. Depending on the plating methods used, the tin terminations may be susceptible to tin whisker growth. These tiny hair-like filaments of conductive tin can grow out of a component lead and, as they grow, may touch an adjacent device's lead, which then causes a short and, ultimately, the failure of the device. Component manufacturers have tried to develop whisker growth mitigation techniques that include changes to the plating process such as using a nickel barrier between the copper and the tin in addition to other methods, but the mechanism is not completely understood. So, for assemblers, there is still quite a bit of concern about the risks posed by tin whiskers. And, in the high-reliability world where there is no room for error, this lack of confidence in plating-based solutions has led assembly specialists to seek other methods of whisker risk mitigation.

Tin Whiskers can cause disastrous failures but risks can be mitigated with certain techniques.



One of the more effective techniques used to reduce tin whisker shorts is the use of conformal coating materials. When the proper material is used, conformal coatings can help reduce the chances of whiskers bridging between components. It should be noted that conformal coatings will not prevent tin whisker growth, but they have been shown to mitigate the risks posed by tin whiskers. Like any material selection, understanding the requirements of your process and the abilities of the material are critical to success -- not just any conformal coating will suffice. Both acrylic and epoxy conformal coating systems are very rigid and don't allow for a lot of give and, therefore, the ability for tin whiskers to grow through the cured coating. Epoxy coatings offer the greatest level of protection due to their rigid nature and tightly cross-linked chemical structure, which improves the overall chemical resistance of the coating, thus enhancing the in-use resistance to spread of tin whiskers. The materials used must provide good bonding to the surface so that the PCB is coated completely and very evenly, which is particularly important through the thermal life of the board. Matching the adhesive and thermal properties of the coating to the application is critical. When used properly, even if a tin whisker does

grow out of a lead, the conformal coating should prevent it from re-entering the coating and causing a short on an adjacent component.

As manufacturers have a variety of different process and final reliability requirements, partnering with a supplier who can deliver several options for conformal coating solutions and in-depth technical expertise is important. As a global leader in electronics materials development, Henkel has engineered several conformal coating products that offer the choice today's manufacturers require. For those applications where a thermal cure is desired, Henkel offers both epoxy and acrylic solutions. Hysol® PC12-007M™ is a thermally cured, epoxy-based material that delivers excellent stability at higher temperatures, so is ideal for automotive applications where under-the-hood conditions can become extremely hot. When high temperature extremes (above 110°C) are not a concern, Henkel's Hysol PC20M™ offers an acrylic-based system that provides the hardness required to help mitigate tin whisker re-entry. Sometimes, however, manufacturers can't use thermally cured materials because of the presence of temperature-sensitive components. In this case, Henkel's two ultra-violet (UV) cure systems, ECCOCOAT® UV7993™ and Hysol PC40-UM™ provide options for those manufacturers who must use an alternative to thermal cure. All of these materials offer the properties required to help reduce the risks posed by tin-whiskers.

In instances where assemblers may not wish to use conformal coatings at all due to solvent concerns or the investment in required for spraying equipment, Henkel has formulated material and process alternatives in the form of our Macromelt® low-pressure molding encapsulants or potting materials. Macromelt OM646™ is a low pressure overmold material that offers superior rigidity and product protection with the side benefit of reducing tin whisker-related shorts. With this process, the entire PCB is encapsulated at low pressure with a very rigid material that is capable of dealing with low temperature components, yet delivers excellent performance in a variety of end use environments. The process is fast, simple and cost-effective. For those that prefer a potting process, Henkel's Hysol ES1002™ fits the bill. An epoxy system that can be room temperature or heat-cured, Hysol ES1002 is designed with hardened fillers for advanced physical properties for superior performance.

Depending on your individual volume requirements, design constraints, reliability needs or process conditions, Henkel has a solution for tin whisker risk reduction. And, as always with Henkel, our materials are backed by expertise, unmatched technical service and the global resources you'd expect from the leading electronics materials supplier.

For more information on Henkel's answers to tin-whisker induced failures or any of our advanced materials products, log onto www.henkel.com/electronics or call our Irvine, California headquarters at 949-789-2500.