

Japan's Best-Kept Pb-Free Secret

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The Pb-free/RoHS (*Reduction of Hazardous Substances initiative*) juggernaut is gaining momentum around the world. In response, new processing parameters are being developed by the large players on the worldwide electronics stage. They in turn are passing draft standards down the supply chain to suppliers, subcontractors and contract manufacturers. What's bubbling back up can at best be described as confusing. At worst it could be a reliability nightmare.

The good news is this exercise is pushing the electronics industry toward standardization before expensive process changes have been graven in stone. This standardization will eventually be based on the recommendations of three standards bodies: JEDEC in the U.S., EIC in Europe, and JEITA in Japan. Unfortunately, they're not currently in consensus.

One of the primary disagreements is over the use of low concentrations of Bismuth in the alloy used to plate leads to suppress whisker growth. The majority of the folks at JEDEC say no to Bismuth, and have put their support behind the use of Matte Sn lead plating. At JEITA, they recommend the SnBi alloy. While both base their recommendations on a great deal of research, their arguments *against* the other's solution seem a bit shaky. The

good news is the two are not basically incompatible, Matte Sn-plated and SnBi-plated leads can coexist in the same production environment.

JEDEC's primary objection to Bismuth might be described as a knee-jerk reaction based on past problems with Tin Bismuth *solders*. When these solders were used on parts with SnPb-plated leads, a ternary SnPbBi eutectic alloy could form. The low melting point of the alloy could cause the solder joints to weaken at high operating temperatures, resulting in field failures. The use of Bismuth in *lead plating* is an entirely different story. SnBi plating employs such low concentrates of Bismuth (1 to 5%) that a SnPbBi alloy can not form. The *National Institute of Standards and Technology* (NIST) has demonstrated that even in worst-case scenarios, the cooling kinetics of the solder joint will not allow it to happen.

There are several reasons why half the world prefers Bismuth. First of all, it's been shown to be effective in the suppression of solder whisker formation under NEMI (*National Electronics Manufacturing Initiative*) standards for storage and thermal cycling environments. Bismuth also lowers the melting point of the plating alloy to just over 200°C making it compatible with standard SnPb solder profiles. Plus the addition of Bismuth to the plating improves the wetting performance, especially over time. Finally, testing has proven that the long-term reliability of the solder joints of SnBi-plated leads is comparable to that of standard SnPb-plated leads — no matter which solder paste is used, Pb-based or Pb-Free.

Manufacturers of Matte Sn components also claim compatibility with SnPb solders, but because it has a much higher melting point than SnPb solder, it should be noted these claims assume that only *high temperature* Reflow profiles are used. It should also be noted that when higher Reflow temperatures are *not* used, severe wetting problems can occur. Finally, Matte Sn plating is not recommended for use on Alloy42 lead frames. They can be plated with the Bismuth alloy with no problems.

With all of these advantages, why isn't the Bismuth solution taking the market by storm? I feel that it's largely a political issue. Both the JEDEC and the JEITA companies have huge investments in time and resources in their respective approaches. Since both continue to stand firm, the decision as to which technology to choose will be pushed into the marketplace for resolution. Fortunately, the choice does not have to be mutually exclusive. Since Matte Sn and SnBi devices can be freely mixed on a circuit board, U.S. manufacturers can take advantage of *both* technologies. Japan's approach to eliminating toxic materials from our environment doesn't have to remain a secret. It's not only a proven alternative to Matte Sn, it's a superior one.