



**PRECISION
PLATING
COMPANY**

Our Mission: Impeccable Service

Lead Free: RoHS Compliance

by Vince Azzano

The Lead-Free Challenge

July 1, 2006, was the date when the EU (European Union) Directive on the **Restriction of Hazardous Substances (RoHS)** went into effect and required that all electronic products sold in Europe be lead free. International OEMs are more sensitive to this issue every day, and recently have begun to put pressure on their suppliers to support them in the development of their lead free strategies. Resistance to this change is all but a memory now as companies throughout the electronics supply chain are being forced to consider the practical steps that they must take in order to make the change to lead free.

For many decades now the electronics industry has been using tin-lead as an electrodeposited contact finish and solder joint material. Environmental concerns regarding the lead content of electrical and electronic assemblies have been increasing steadily over the past few years and the electronics industry has been pressured to eliminate lead from its products and processes. Even though industry sources report that electronics manufacturing accounts for less than 1% of the total lead used industrially, pressure continues to mount for global compliance with regards to lead free solderable deposits.

The "lead-free" movement has its most direct origin from enacted and proposed legislation in Japan and Europe. These legislative activities, combined with the growing expectations for corporate environmental responsibility have had a significant effect on manufactures throughout the electronics supply chain.

The ban of lead in Europe and the Far East threatened U.S. exports to those markets. Consequently, most of the large U.S. OEMs have already enacted their own lead-free strategies. Pure tin has been identified as most cost effective and functional alternative to tin-lead for electroplated component finishes. Several major OEM's both in the international and the domestic market place have chosen pure tin as their standard lead-free electroplated component finish.

For the past several years Precision Plating has been working on this issue with our plating solution suppliers, testing and evaluating various solutions in a production environment. Precision offers lead-free, pure tin plating finishes, both matte and bright, for those customers that have lead-free requirements. These new, pure tin electroplating chemistries have been specifically formulated to provide a whisker resistant, lead-free deposit that provides a drop in replacement for most applications that are currently utilizing tin-lead.

Lead Free Tin Isn't The Only RoHS Compliant Finish

While many companies may be scrambling to meet this deadline, many more have already made the change. Those companies that have been proactive in terms of implementing their lead free strategies have put themselves in a strong competitive position, as RoHS becomes a reality. It is never too late to develop a lead free alternative, and with our knowledge and experience in this area we can help you get up to speed quickly and painlessly.

PRECISION WHITE PAPER



PRECISION PLATING COMPANY

Our Mission: Impeccable Service

PRECISION WHITE PAPER

Several major electronic OEMs in the international market place have chosen pure matte tin, over a nickel underplate, as their standard lead free component finish. Precision Plating offers lead free, pure tin electroplated finishes for those customers that have specified a lead free tin finish. These relatively new, pure tin electroplating chemistries have been specifically formulated to provide a whisker resistant, lead free deposit that provides a drop in replacement for any applications that are currently utilizing tin-lead.

However, tin over nickel is not the only alternative. In a recent paper published by **iNEMI** (**I**nternational **E**lectronics **M**anufacturing **I**nitiative) several different lead free component finishes were discussed along with their relative risks with regard to whisker growth. iNEMI is an industry-led consortium whose mission is to provide cohesive leadership and direction in the global electronics manufacturing supply chain.

The specific paper mentioned above was published by the iNEMI Tin Whisker User Group. This group was formed to develop recommendations for lead free finishes on components that would minimize the risk of failures from tin whiskers in electronic applications. The iNEMI Tin Whisker User Group consists of members from eight large manufacturers of high reliability electronic assemblies. The companies represented by these members are Agilent, Cisco, Delphi, Hewlett-Packard, IBM, Lucent, Sun Microsystems and Tyco Electronics.

While pure matte tin over a nickel underplate is high on the iNEMI list of recommendations, nickel-palladium-gold flash was given their highest recommendation. This plating scheme was developed by Texas Instruments in the late 1980s, as a solution for the lead frame industries yield loss which was due to post plating solder onto the leads. At that time Precision Plating was working closely with T.I. during the qualification stages of the development of this finish. In fact, some of the first lead frame samples to be plated with this finish were plated right here at Precision. Today this finish has well over a ten-year history in lead frame production and Precision Plating is the premier job shop provider of palladium finishes in the United States.

Nickel-palladium-gold is not prone to whisker growth and the iNEMI Group highly recommends this finish for lead frame applications. However, the use of this finish is not limited to lead frames. In fact, this finish is very versatile and can be used in virtually any solderability application. Of course palladium and gold are noble metals and cost can be an issue, however, depending on the application, the thicknesses of these metals can be kept very low and in many cases the cost impact is minimal. However, in fine gold wire bond applications where nickel-palladium-gold would replace post-plated tin in IC manufacture or where palladium over nickel is replacing aluminum inlay in aluminum wire bond applications, this finish can represent a significant cost savings!

Once again, in those applications where nickel-palladium-gold isn't a practical alternative from a cost stand point, pure matte tin over a nickel underplate is the finish of choice. Recent testing performed by our solution chemistry partners have shown that the whisker risk of these new lead free tin finishes is minimal when they are plated over a nickel underplate. In the iNEMI paper, matte tin over nickel was very highly recommended, second only to nickel-palladium-gold.



PRECISION PLATING COMPANY

Our Mission: Impeccable Service

PRECISION WHITE PAPER

In those applications where a nickel underplate can't be used, the best whisker mitigation strategy is reflowed tin. Precision has several applications, primarily in the automotive industry, where lead free tin is reflowed using an economical in-line process. Reflowed pure tin was also high on the iNEMI list of recommendations.

Lead-Free Reflow and Solderability Problems

The advent of lead-free solders and the lead-free, pure tin plating finishes has resulted in some solderability problems that didn't exist with the old tin/lead soldering systems.

As a result of the push to eliminate lead in electronics most of the solder assembly operations occurring today are utilizing lead-free solder pastes and/or lead-free wave solders. These lead-free solders are usually some combination of tin and silver and sometimes copper. For example, one widely used lead-free solder is 96.4% tin, 3.5% silver and 0.6% copper. By using these lead-free solders you don't lose anything in terms of solderability, however, the melt point of these solders is much higher than eutectic tin/lead solder. The 96.4% Sn/3.5% Ag/0.6% Cu alloy mentioned above for example has a reflow temperature of about 217 degrees C which is 34 degrees higher than 63% Sn/37% Pb, which has a reflow temperature of about 183 degrees C.

What this means is that the solder temperatures and reflow oven profiles have had to increase 34 degrees C in order to insure the same dwell time at temperature as they had when using tin/lead. Since the formation of intermetallic compounds such as tin/copper or tin/nickel occur at a much faster rate with increased temperature, the likelihood of thick intermetallic layers and potential solderability problems has also increased. We have seen oven reflow temperatures as high as 285 degrees C and 260 degrees C is not uncommon.

This is especially true for to applications that require multiple reflow operations such as double sided circuit boards and some chip capacitor assembly operations.

Another common problem that has been commonly seen is a yellow discoloration of the lead-free pure tin plating finishes at these higher reflow temperatures.

Here at Precision Plating we have been able to provide our customers with lead-free, pure tin plating finishes that survive multiple, high temperature reflow operations without any degradation of solderability and without any discoloration. We have even been able to provide parts that pass 8-hour steam aging after two reflow cycles of 30 seconds at 260 degrees C!

Some of these customers found Precision only after suffering through several other plating suppliers that couldn't provide lead-free, pure tin plated product that survived these stringent applications.



PRECISION PLATING COMPANY

Our Mission: Impeccable Service

We Are Here To Help Educate

Even though the RoHS has been in place for a while now, there are still many companies in the electronics industry that are just beginning to investigate the impact of these requirements or starting to feel the unintentional stress with their production process. Precision has been working with many of our customers on compliance issues and in some cases, very closely with large OEM's. Consequently, we have made ourselves available to field customer questions and inquires regarding lead-free plating alternatives and help educate customers in this area. We have even provided engineering presentations, at customer locations, for those customers that wish to learn more about lead-free alternatives.

Our 100 years of electroplating engineering experience uniquely positions us to be able to respond to these changes. If you would like more information on this subject please feel free to contact us directly, or you can visit our web site at ppc1904.com. On the web site we have links to the iNEMI paper mentioned in this article and a link to the actual text of the EU RoHS directive. Don't hesitate to contact us today with your plating related issues. We're up to the challenge!

PRECISION WHITE PAPER