# Mixing Tin/Lead and Lead-free Technologies.

As electronic manufacturing in North America and throughout the world moves to lead-free assembly there will be a transition period from tin/lead to lead-free. During this transition period assemblers will be working with both tin/lead and lead-free components, boards and assembly materials. The question arises, what are the potential problems/concerns when combining tin/lead and lead free technologies on a given assembly?

One potential problem or concern is what will happen to the reflow temperature of a process that involves mixing technologies. This paper will address that question. This question is more of a concern for wave soldering where contaminants can build up but can also be applicable to surface mount and hand soldering.

The answer depends on whether you are adding lead-free materials to a traditional tin lead/process or whether you are introducing tin/lead materials to a lead-free process.

**The Tin/Lead Process**

The tin/lead process is what is currently being done for the majority of electronic assembly in the US and throughout North America and Europe. What happens when lead-free components are put in place in assembly of this current technology?

Fortunately for assemblers the news here is good. Studies indicate that there are no reliability or processing issues when lead-free plating and finishes are used on components. In fact, lead-free components finishes have been used in electronic assembly for many years.

The addition of extra tin does not raise the reflow temperature of the alloy. While more tin may dilute the amount of tin/lead intermetallics present, the tin/lead intermetallics do not go away and so the reflow temperature of the resulting alloy does not change

**The Lead-free Process**

When assemblers move to lead-free connection materials the same question arises concerning using components with tin-lead finishes. The news here isn't so good. The addition of small amounts of lead to lead-free connections can have a dramatic affect on the alloy integrity.

When lead is added to a lead-free system the lead reacts with the tin forming the same low temperature intermetallics that are present in tin/lead systems. Even small amounts of tin/lead intermetallics will lower the reflow temperature of the alloy.

The solder alloy temperature is usually described in terms of liquidus and solidus. Liquidus is the temperature at which the alloy changes from a plastic state to a liquid. Solidus is the temperature at which the material changes from a plastic state to a solid.

The addition of lead does not affect the liquidus but it does change the solidus of the resulting alloy.

An example of how much the reflow temperature can be affected by the addition of as little as 1% lead is shown below:

1% lead will drop the solidus by 40-50°C.

| | |
|---|---|
| SnCu0.7; | 227°C to 183°C |
| SnAg3.0Cu0.5; | 220°C to 179°C |
| SnAg3.5; | 221°C to 179°C |
| SnBi57; | 138°C to 96°C |

**Conclusion**

When mixing tin/lead and lead-free technologies it is important to note which technology you are trying to achieve. For a tin/lead technology adding lead-free components will not change the reflow temperature. For lead-free technology adding leaded components will lower the reflow temperature.