

Lead-Free Alloys: Stainless Steel Erosion

Factors Affecting Erosion

When changing to a Lead-Free wave solder process it is important to consider the effect that the high Tin alloy will have on the life of the wettable parts of the wave solder machine.

It is widely recognized * that all high Tin solders will erode parts more quickly than the traditional Sn/Pb wave solder alloys. The rate of this erosion is dependent on various factors:

- **Temperature of the alloy:** *Generally the higher the alloy temperature a greater amount of erosion will occur.*
- **Contact materials:** *Mild steel will erode very quickly, Stainless steel is fairly resistant, cast iron has a very good resistance and titanium will not erode.*
- **Alloy formulation:** *There is some evidence that higher Silver content alloys such as SAC405 and SAC305 will erode stainless steel much more quickly than lower silver content alloys such as SACX™.*
- **Condition of wettable parts:** *Stainless steel that has been damaged by impact or scratched will start to erode due to the oxide layer on the stainless steel being damaged and allowing the Lead-Free alloy to wet the stainless steel. When wetting has commenced erosion starts to take place.*
- **Turbulence of the moving metal:** *Areas on the wave solder machine where the Lead-Free alloy has a high velocity and a large amount of turbulence will suffer the most damage over time. Oxide particles also influence the rate of erosion, these hard particles can damage the surfaces through abrasion – breaking down the oxide layer on the stainless steel which then allows the Lead-Free alloy to wet the surface.*

Changing to a Lead-Free Wave solder process

There are 2 different situations that a user will face when making this change.

1. **Filling a new wave solder machine with Lead-Free alloy:** The machine manufacturers have conducted investigations into the most suitable protection for new machines and will provide this as part of the machine specification. Consult with your machine manufacturer for more details.
2. **Filling existing wave solder machines that have been used for Sn/Pb and do not have wettable parts that are specially treated for Lead-Free:** Generally a machine in this situation will be greater than 5 years old. It is important to make an assessment of the condition of the stainless steel wettable parts, these may be in good condition or may be worn through many years of use. If using SAC305 or SAC405 alloy it is recommended that you consult the machine manufacturer to discuss suitable coatings or upgrades for your machine. If using SACX™ alloy you can take the decision to fill the machine ** without applying any special treatment to the wettable parts. If your machine is in good condition and you pay attention to the factors listed above you may get 2 –3 years of output from the machine before having to replace any parts. It is recommended if taking this approach that the frequency of preventative maintenance (PM) be increased with particular attention being paid to the condition of the wettable parts and welded seams in containment pots. Inspection for the presence of FeSn₂ inter-metallic needles should also be added to the PM schedule as these are an indicator of erosion and can cause shorts on the PCB.

* The 3 largest producers of Wave Solder machines support this statement.

** Pot must be cleaned with a Tin wash – see RB Changing wave solder bath from Sn/Pb to Lead-Free