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Overview

With July 1st 2006 in mind the use of lead-free alloys in hot air solder leveling and component assembly is a subject of increasing interest to people working in the electronics industry. For more information click on associated links: www.Leadfree@ipc.org www.lead-free.org. While some have viewed the change with skepticism, most people recognise they now need to get their house in order.

It is interesting to note that the Japanese electronics industry has for a number of years been successfully manufacturing lead-free products. Many high profile Japanese satellite companies located in other countries have changed to using lead-free solder, pastes, components and PWB's.

Three years ago Cemco-FSL began testing lead-free solder as part of a project headed by Northern Telecom (Nortel). Component and paste suppliers also participated in the studies to determine the viability of using a tin/copper alloy (Sn99.3/Cu0.7) compared to other lead-free finishes. Sn/Cu was chosen because it was the least expensive of all the alloy alternatives. A 'Quicksilver' vertical hot air leveler and an 'Alchemy' horizontal leveling system were used in the test program. While the quality of finish from the horizontal system was better (as it is also with Sn/Pb), the conclusion was that eutectic Sn/Cu applied using either a vertical or horizontal hot air solder leveling (HASL) was an acceptable alternative to Sn/Pb.

Since then Cemco-FSL has engaged in further testing using a patented alloy comprising Sn/Cu with the addition of nickel (Ni). The quality shows a definite improvement over standard Sn/Cu in terms of uniformity. It has better solder drainage and dispersion over the surface of the pad and has an aesthetically pleasing brighter finish, not too dissimilar to Sn/Pb. It also has the added advantage of permitting a vertical solder pot temperature of 260-265˚C which is only marginally higher than Sn/Pb, typically 250˚C, whereas Sn/Cu requires a temperature of 280˚C.

Unlike vertical leveling that requires a panel to be immersed in the solder for approx. 2 seconds excluding the time for panel insertion and withdrawal, the panel/solder contact time in a Alchemy Horizontal leveler is typically 0.1-0.2 seconds. As a result the solder temperature is set between 275-285˚C to allow sufficient heat transfer to enable the solder to flow across the pad while clearing the holes.

In light of past and ongoing tests and the positive results gained from them, HASL is no longer being dismissed as a 'non compatible' surface finish for lead-free processing. HASL is currently the preferred finish within the assembly industry and all indications suggest it will continue to be so for the foreseeable future. Nothing is more solderable than solder!

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Recommendations

In anticipation of the future move towards the use of lead-free solders, Cemco-FSL is pleased to provide recommendations for users of 'Quicksilver' vertical levelers. The purpose of the following questions and answers is to highlight what changes may be necessary to accommodate lead-free solders and to ensure a safe transition and also to provide answers to commonly asked questions.

Cemco-FSL has manufactured a range of Quicksilver models over the past 18 years and these vary in design and may require different considerations when assessing their suitability for lead-free conversion. Users wishing to convert to lead-free solder are advised to do so only after their machine has been carefully audited by a qualified Cemco-FSL engineer or appointed agent.

Questions and Answers

Q1 **I have an older style 'side arm' insertion 'Quicksilver' machine. Can I process panels with lead-free solder?**

A1 Yes. However, side arm machines are generally fitted with lower capacity heaters and therefore will require a heater upgrade to the solder pot and air knives.

Q2 **Will I require any wiring changes?**

A2 If up-rated heaters are to be fitted it is likely that the cable sizes and relays will also have to be replaced to accommodate the increase in power. Earlier machines were fitted with PVC conduit for the sump heater circuitry. This will not withstand the higher operating temperature and will need replacing with steel conduit.

Q3 **Can I use my existing temperature controllers?**

A3 Yes. Modex and West controllers are suitable up to 300˚C.

Q4 **Lead-free solder has a melting point higher than that of SnPb, will the safety interlocks or over temperature controllers require changing/re-setting?**

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A4 Yes. There are two safety interlocks. One is to ensure the solder pump is not energised until the solder is fully melted. The second is sump zone interlock that allows the dip zone to heat the solder to its melting point prior to energising the pump zone heaters.

When using SnCu the Solder pump interlock should be set to 245˚C and the sump zone interlock should be set to 215˚C.

If 'Modex' temperature interlock units or over temperature controllers are fitted they will need to be changed to 'West' units.

Q5 There has been much discussion about accelerated wear to the solder pots in wave soldering machines, is this likely to happen with my leveling machine?

A5 Experience to date using Nihon Superior SnCuNi suggests little difference in erosion rate compared to standard SnPb. It has been suggested that stainless steel with a high nickel content may wear but it should be noted that the Quicksilver solder pot is fabricated from a high-iron content boilerplate.

Regardless of the age of the machine, it is recommended that the pump and its seating be inspected to determine if replacement or repair is necessary prior to a lead-free conversion.

Q6 What is the operating temperature for use with SnCu?

A6 Standard SnCu requires a solder pot temperature of 275-280˚C. Nihon Superior and SnCuNi alloys require a pot temperature of 260-265˚C. All alloys require an air knife temperature of 280˚C.

Q7 What is the dwell time for the panel to be immersed in the solder?

A7 Typically 3-4 seconds. Field experience has found that a double dip of 1-2 seconds dwell per dip produces a surface finish similar to SnPb. The first dip initially pre-heats the panel and allows the copper to wet with solder. The second dip permits the solder to reflow uniformly across the surface features while clearing the holes.

Q8 Will the increase in operating temperature cause excessive panel warp?

A8 Not necessarily, this will depend largely on integrity of the panel fabrication. However, subject to panel thickness it will become more flexible. A solder pot guide kit is available to ensure the panel path is kept straight during immersion and withdrawal cycle.

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Q9 Do I need to change my pre-treatment chemistry?

A9 All tests to date have been carried out using standard proprietary pre clean chemistry and Quicksilver fluxes as formulated by Enthone as used with SnPb HASL. Additionally R&H and BECE-Chemie chemistry has been used with good results. We recommend contacting your chemical supplier to ensure the flux used will operate at the higher operating parameters.

Q10 Is anyone using lead-free solder in their Quicksilver Hot air leveler?

A10 Yes. Quicksilver and Cemco solder leveling services in the UK each have a Quicksilver leveler using Nihon Superior solder. There are more than 50 Circuit board fabricators in Europe supplying lead-free surface finishes.

Q11 Are there any cost implications transferring to Lead free solder?

A11 Initially this will depend largely on the age and condition of your leveling machine. Lead-free solders are generally more expensive than SnPb (expected to be in the region of 2-3 times).

Q12 Has Cemco-FSL conducted lead-free tests using the Alchemy Horizontal leveler?

A12 Over the past three years Cemco-FSL has been party to a number of test programs involving major assemblers and component manufacturers. A copy of one of the test programs and power point presentation can be seen at www.cemco.com As anticipated, the horizontal systems proved capable of producing superior results to that of vertical systems.

Q13 Can I have test panels processed to determine capability?

A13 Cemco-FSL will be pleased to process your panels using either the Quicksilver or Alchemy leveling systems. Horizontal leveling testing is subject to machine availability and therefore by arrangement. For small batches up to 10 panels the service is free of charge, however carriage is chargeable.

Updated 26th September 2005