QA Technology Company, Inc.

A p p l i c a t i o n s N o t e

Test Probes in Lead-Free Solder PCB Processes

New regulations will require the use of Pb-Free solder for many assemblies by July 1, 2006. This issue has prompted QA Technology to research the impact this will have on the selection of ICT probes. QA Technology has worked closely with solder manufacturers to determine what will be the major factors to consider. Here is an overview of these factors:

Reflow Process- This process is the most affected by the switchover to Pb-Free. The recommended ovens should generally have a minimum of seven (7) zones, which are needed to provide the proper ramp and hold times required for Pb-Free solder paste. This is to insure that the board and its components reach the higher reflow temperatures required for Pb-Free solders. Nitrogen is recommended in the reflow process to help improve the wetting between the board and the components. Older reflow ovens will have the most difficult time whereas modern ovens that can more accurately control the ramp up times and temperatures will have better results.

Wave Soldering- Because of the increase in melting temperatures (218°-227°C versus 183°C) associated with Pb-Free alloys, added maintenance is required. Tin is reactive and will eventually corrode the stainless steel solder pots and components. The high tin alloys dissolve the actual materials used in this equipment. Parts will need to be replaced with cast iron or coated with a material that will protect the surfaces. A more active liquid flux may also be required.

Selection of Components- Pb-Free should be done completely to insure the reliability of the product. It is recommended that you avoid mixing Pb-Free solder with tin lead components on the same board.

Cross Contamination- Any time a probe contacts a UUT, some of the flux or solder paste that makes up the contact will be transferred to the probe tip. The residues may be minimal and insignificant but the possibility exists that these residues will transfer to subsequent boards being tested. The transfer of lead residues does not end here. As a UUT is tested, particles of the contact (lead, tin, flux etc.) are fragmented during the test and fall into the fixture. As the fixture is cycled, these contaminants are spread throughout the fixture and related test equipment by the vacuums pull-down and release cycles. As a result, these contaminants can be deposited onto a lead free UUT. These contaminants are frequently seen when cleaning the equipment. Keep in mind that if a product line is converted from leaded to lead free, the first boards tested will have the highest concentrations of lead contamination while subsequent boards will have a lower contamination level.

By just changing to new probes, you are not guaranteed that you will have a Pb-free environment. A complete rework/cleaning of the test unit and all fixtures would be required. Depending on the application and level of lead allowed, you may need to go to even greater steps.

Inspection- Because of the larger grain structure of Pb-Free, the solder joints appear dull and pitted- this appearance does not mean it is not a good solder joint.

Test Probes- In test environments, the flux is going to be the problem area. The flux must be designed to be thermally stable. Because the flux has to withstand the higher reflow temperatures (240°C versus 215°C) associated with Pb-Free, they will be harder to penetrate due to "charring" and chemistry breakdown. Some of the fluxes that we tested tended to "fracture" and stick to the tips. This is similar to what we saw when no-clean fluxes first came out requiring more maintenance for test probes. Incidentally, the "domed" surfaces of the Pb-Free pads were relatively free of solder flux. Most of the flux pooled around the base of the pad. Contacting the pad at the base could be a potential for false test failures. Flux chemistry is still evolving and future fluxes will be more compatible with the higher reflow temperatures.

We have found that all Pb-Free test pads were easily contacted with probes with sharp points. Even low spring force probes will work with Pb-Free as they left nice witness marks on the surfaces with low recorded resistance levels. To insure the best possible test environment, work closely with your solder manufacturer to make certain that the solder is being applied to the manufacturers recommendations. Make sure the solder is labeled as “Pin Probable” on the material specification sheet supplied with the solder.

In summary, QA Technology recommends that Pb-Free finishes be tested with:

1) Tip Styles: Ultimately, the selection of point styles is a subjective decision. Experienced test engineers will often have different preferences for the best point styles to use on a given contact surface. QA recommends sharp pointed tips.

2) Spring Forces: Feedback from production test environments that have changed lines to Pb-Free solders have had to select the next higher spring force option. In some cases, the existing spring forces and tip styles were adequate.

3) Plungers: Steel plungers are recommended to help increase probe tip life when contacting the harder and possibly more abrasive flux residues.

Maintenance- Monitor tip cleanliness and perform maintenance as necessary (See QA Technology’s *Probe Maintenance* Application Note for detailed information).

Please refer to www.leadfree.com for additional information.