

MicroScreen[®]

1106 South High Street, South Bend, IN 46601
Phone: 574-232-4358 FAX: 574-234-7496
email: info@microscreen.org
www.microscreen.org

Identifying Stencils for Lead-free Solder Paste

July 1, 2006, marked the era of lead-free electronics in Europe. The influence of RoHS and WEEE will result in better environmental quality, protection of human health, and more rational use of natural resources. But the removal of lead from electronics will bring massive changes for all companies in the supply chain.

By Holly Wise

Beginning with the July 1, 2006, deadline, all suppliers were required to make changes to ensure compliance with the lead-free requirements of RoHS. On the surface mount production line, both OEMs and EMS providers are faced with several challenges with the emphasis on materials and process traceability. The process includes print accuracy and the alignment of the stencil to the PCB. Material changes incorporate special tooling such as stencils. This will require two stencils for the same production run because the same stencil cannot be used for both - the lead-bearing stencil will contaminate the lead-free batch.

The lead-free printing process should demonstrate a similar performance as the lead-based paste printing process, i.e. stencil life, print definition, and repeatability - provided no density issues exist with the paste. In general, no major changes to the printing process should be required. However, because tin/lead solder tends to have better wetting than most lead-free alloys, some stencil-design modifications may be needed to maximize paste spread and counteract inferior wetting. Depending on the materials and components used, if wetting is not sufficient, stencil design modifications may be needed. For example, rather than producing stencils with reductions of the aperture, we may have to look at running the stencil 1:1 with the board. This is a trade-off because going 1:1 with the board may result in more defects during the assembly process. It would be advisable to administer a test run on a current stencil to confirm acceptable spread and wetting.

Paste Characteristics

Due to paste-release characteristics and lower wetting forces, the use of a material other than standard stainless steel should be evaluated for the lead-free stencil. Materials with higher nickel content offer more lubrication (less friction), improving paste release. This material, which is currently used to manufacture stencils for ultra-fine-pitch or μ BGA, offers better paste transfer and volume.

Lack of spreading during the reflow process requires a tighter process window, making the aperture position on the stencil and the placement of the solder on the pad more critical. Tighter control of registration from stencil to board is mandatory to maximize pad coverage, especially when placing components such as 0402. If the positional accuracy of the stencil is off, it will compound alignment issues (Figure 1).

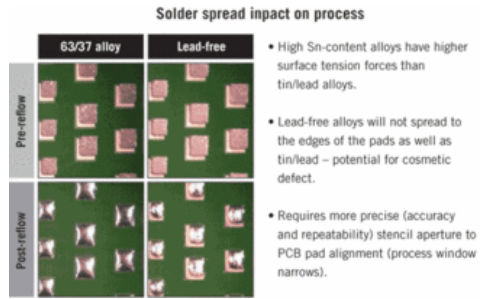


Figure 1. 0603's and 0805's printed with lead free solder paste before and after reflow. There is a lack of spread during the reflow process. Photo courtesy of Speedline Technologies

Inspection and Accuracy

When using lead-free, it is more important that the positional accuracy of the stencil be verified prior to use. This makes proper inspection procedures a significant feature when determining a stencil supplier that will be a facilitator in the lead-free transition. An automated optical inspection (AOI) system* can be used to ensure positional accuracy and size over the entire stencil. If any of the scanned apertures are misaligned with the Gerber data due to an out-of-focus laser beam or non-calibrated laser equipment, the operator is alerted with a percentage error, and the misaligned apertures are highlighted. In the lead-free environment, stencil manufacturers will require sophisticated inspection systems such as AOI.

Another method to ease the transition to lead-free is to make lead-free stencils distinguishable from lead-bearing stencils to avoid contamination. In this example, the polyester border on the lead bearing stencil is white, while the lead free is manufactured with a green polyester border.



Figure 2. Lead-bearing (l) and lead-free (r) stencils show distinguishing marks to help avoid contamination.

Conclusion

If lead-free isn't on your agenda now, it soon will be. With all involved parties ready and equipped to handle the conversion, problems should be minimal.

- LPKF ScanCheck AOI system, LPKF Laser and Electronics.

Author: Holly Wise, Technical Accounts Manager, MicroScreen, 1106 South High Street, South Bend, IN 46601, may be contacted at (574) 232-4418; e-mail: hollyw@microscreen.org.

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