AIM TECH TIP ARTICLE EFFECT OF UNDER-STENCIL WIPE CHEMISTRY ON PRINT PERFORMANCE

WRITTEN BY TIMOTHY O'NEILL

Solder plus Support

Can a change of solvent in the printer improve SMT printing?

Published in CIRCUITS ASSEMBLY

Any engineer will testify lab testing may not correlate with field results. Laboratory data are developed under ideal conditions to generate accurate and repeatable data, whereas a production setting introduces variables not reproducible in the lab environment.

In this report, AIM's application lab approximated a production environment in a multi-hour printing test to quantify the effect of under-stencil wipe solvent on solder paste performance. This experiment compared isopropyl alcohol (IPA) and a novel stencil cleaner. IPA is not recommended as an in-process stencil cleaner, but is often used because it is inexpensive, effective and readily available. However, IPA is not a constituent of solder pastes and can therefore cause changes to paste that will negatively impact performance.

One example of this change is that paste exposed to IPA can become sticky, thus reducing transfer efficiency. This effect can be easily detected by solder paste inspection equipment (SPI). Subtler changes can result in issues that are more difficult to detect. Solder paste that has been compromised can cause flux buildup on the underside of the stencil. Flux buildup can reduce print resolution, which can lead to a variety of soldering defects, including bridging and solder beads/balls.

A series of 0201 components were chosen for the experiment because they best demonstrate the most challenging aspects of a typical assembly. **TABLE 1** shows dimensions of the stencil apertures for the tested 0201 component. FIGURE 1 shows a section of the test vehicle used for the experiment.

STENCIL APERTURES						
Ref	Length (µm)	Width (µm)	Area Ratio	Stencil Thickness	Components per Board	Pads per Board
0201	368	310	0.82	4mil/100um	30	60

TABLE 1. Stencil Aperture Dimensions.

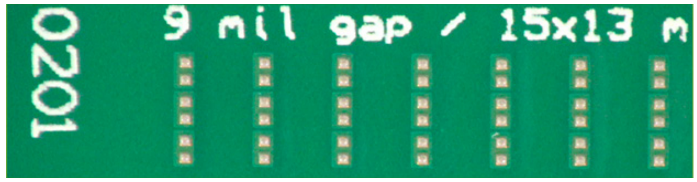

FIGURE 1. Test vehicle showing 0201 component series.

This experiment required simulating a production environment while isolating the effect of the wipe solvent on a SAC 305 no-clean solder paste (**FIGURE 2**). Using the same test vehicle, 80 print cycles were executed in 30 min. with a wet-vac-dry under-stencil wipe cycle performed after every five PCBs. After 30 min., five virgin test boards were printed and SPI height and volume measurements collected. The test was performed for 8 hr. (a typical production shift), and solder paste was not replenished during the duration of the test to minimize dilution of the under-stencil solvent in fresh paste.

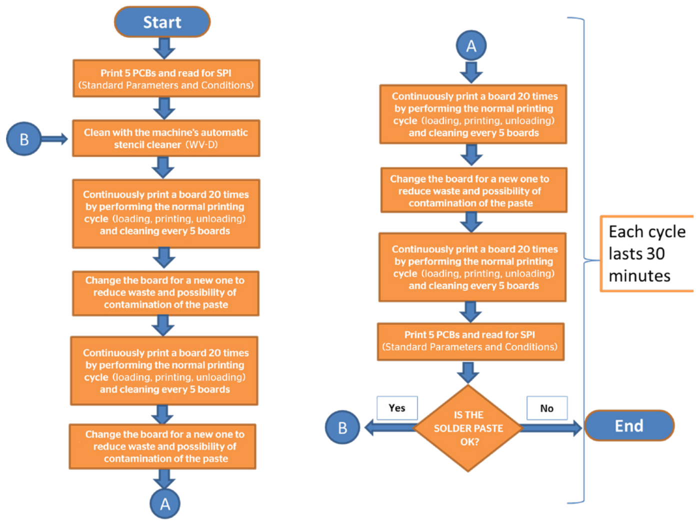

FIGURE 2. Experiment flow chart.

REFERENCE DATA					
Boards Tested	Total Components	Total Pads	Pads per Board	Total Wipe Cycles	Total Print Cycles
80	2400	4800	60	272	1360

TABLE 2. Data Point Measurements.

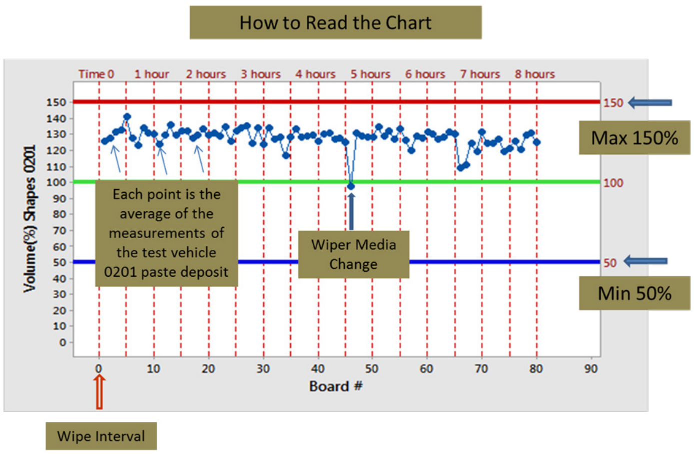

FIGURE 3. Explanation of SPI chart data.

The measured paste deposit volume and height were averaged for each board tested. SPI min./max. limits are commonly set at 100% ±50%. **FIGURE 3** shows how to read the test results. Excess paste volume can lead to defects such as solder beads and bridging where insufficient paste volume can result in difficult-to-detect non-wet opens and increased voiding. Height is also an important measurement because variation in paste height, or "dog-ears," can cause inconsistent soldering performance. **FIGURES 4 TO 7** show SPI results of the paste deposits of a sample 0201 component. Test boards with the recommended cleaner were consistently within the paste deposit limits for volume (**FIGURE 4**) and height (**FIGURE 6**), whereas when IPA was used the values exceeded the maximum limits occasionally for volume (**FIGURE 5**) and repeatedly for height (**FIGURE 7**).

FIGURES 8 AND 9 demonstrate that when using the recommended stencil cleaner, the Cpk value was 1.85, a 5-sigma process, compared to Cpk of 1.25, a 3-sigma process when using IPA. It is important to note the IPA wipe had a significant number of outliers, whereas the recommended stencil cleaner had none. The graphs represent 4200 data points; therefore, what may appear to be insignificant is in fact very important.

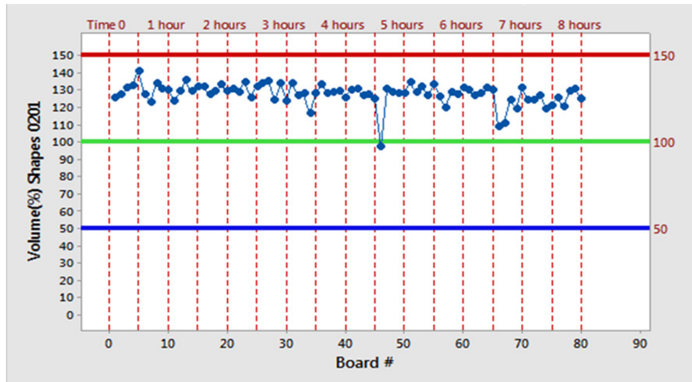

FIGURE 4. SPI values of solder volumes using AIM-recommended under-stencil cleaner.

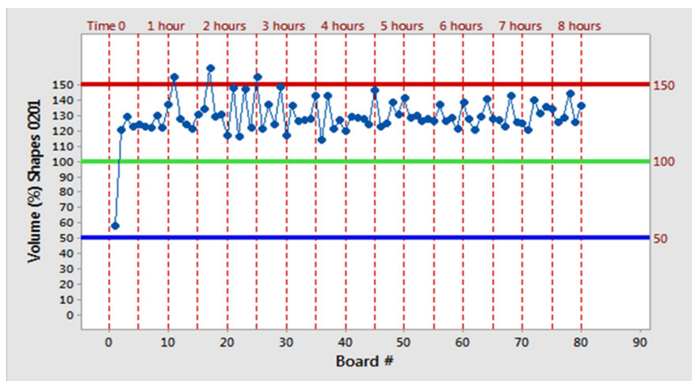

FIGURE 5. SPI values of solder volumes using IPA as under-stencil solvent.

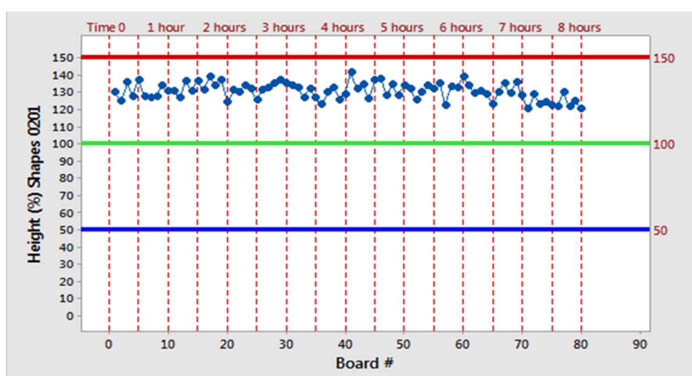

FIGURE 6. SPI values of solder height using AIM-recommended under-stencil cleaner.

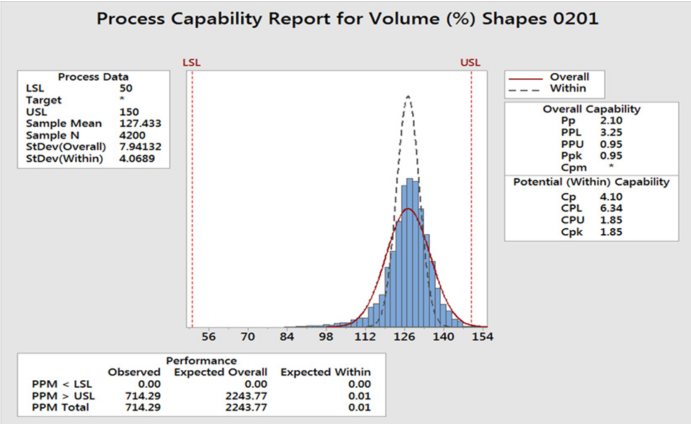

FIGURE 8. Process capability report using AIM-recommended under-stencil cleaner.

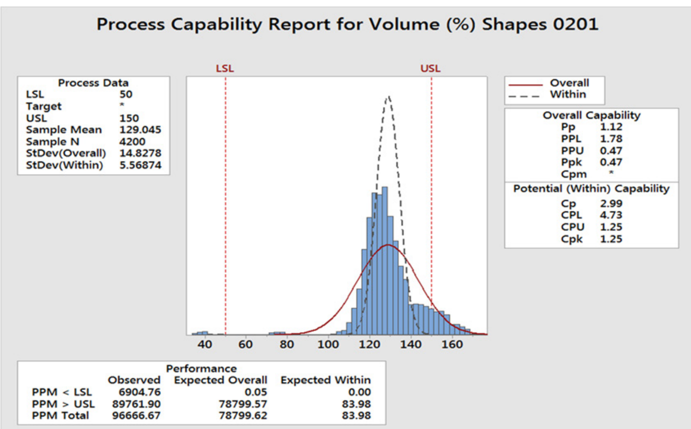

FIGURE 9. Process capability report using IPA under-stencil solvent.

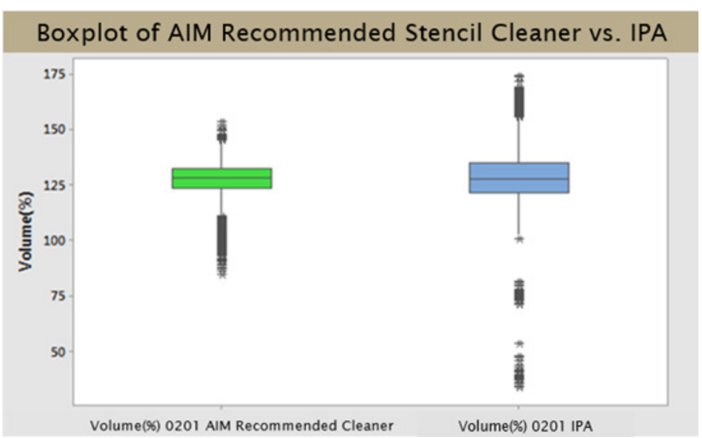

FIGURE 10. Box plots of all data.

Continuous process improvement (CPI) is the foundation of Kaizen and ISO manufacturing principals. A simple change of solvent in the printer is a low-cost improvement that can have measurable benefits in an SMT printing process. Additional benefits may include decreased paste consumption as less paste replenishment is required and reduced wiper media consumption as wipe intervals can be increased.

Acknowledgments

Special thanks to the AIM Soldadura de Mexico Applications Lab Manager, Andres Lozoya, for input on the design of experiment and execution, and Carlos Tafoya, AIM technical support director, for guidance and expertise.