Support Tooling for Reliable SMT Solder Paste Printing

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The printing of solder paste on substrates and FR 4 material is a simple process. The stencil materials and design criteria are well documented and stable. There are many viable options for supporting substrates and PCB materials that create consistent prints; there are drop in units for PCB support that are universal and reduce downward warpage. Gel Packs function in this manner and many users employ dowel pin supports and use the stencil printer side hold down clamps. If the substrate or PCB is warped up, the downward pressure of the squeegee may eliminate the warpage. In applications that pass through reflow and are reverse side printed for double sided assemblies, the substrates or PCBs may warp or "potato chip". In this circumstance, side hold downs and under substrate dowel pin support may not sufficiently reduce the deviation of the PCB. Many users with this challenge will use a dedicated vacuum support that will hold the PCB flat to .002". This method reduces the unknown PCB position which will (See Fig. 2) reduce print defects. Dedicated Vacuum Tooling also eliminates the potential rheological issues of printer head squeegees forcing against an upward warped PCB. Snap-off issues and movement of the PCB Substrate during the print stroke are also addressed because the board is held flat, insuring solder deposition that is consistent with the process design. The industry trend toward micro-assembly with many components and uBGAs having solder pads smaller than .005" on very tight center to center spacing cannot be produced repeatedly if the stencil does not release consistently or moves. Dedicated Vacuum Support Tooling will minimize this challenge.

The trend of using very thin stencil foils (>.005") is also a challenge to process engineers. The ultra thin stencils may coin if the gasket between the PCB and stencil is not tight, or if there is movement. In either event, the stencil may be damaged and need replacement.

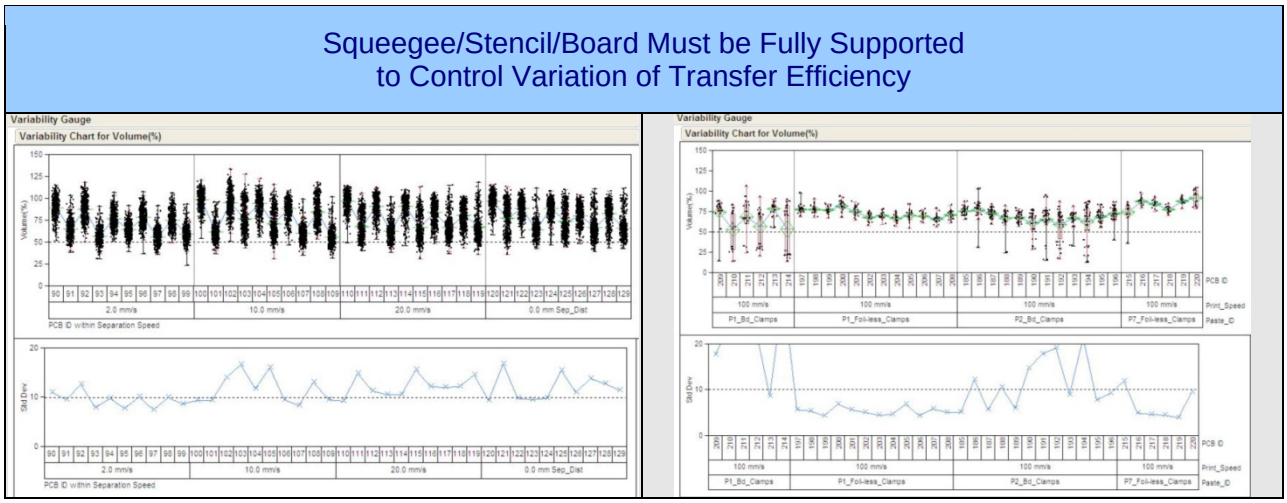
Volume PCB assembly manufacturing may also benefit from dedicated vacuum support tooling. On most automated screen printers, vacuum support tooling may be changed for different production runs in less than 5 minutes. This will eliminate subjectively placed dowel pin PCB supports by operators. The dowel pin supports may potentially damage soldered components. Dedicated Vacuum Support Tooling reduces variables in set-up and position. On double pass assemblies, the vacuum support tooling will accommodate the populated side with designed cavities for components. The dedicated tooling eliminates the possibility of an uneven print surface. The components on the soldered side of the assembly are protected from any pressure and will not affect the print position.

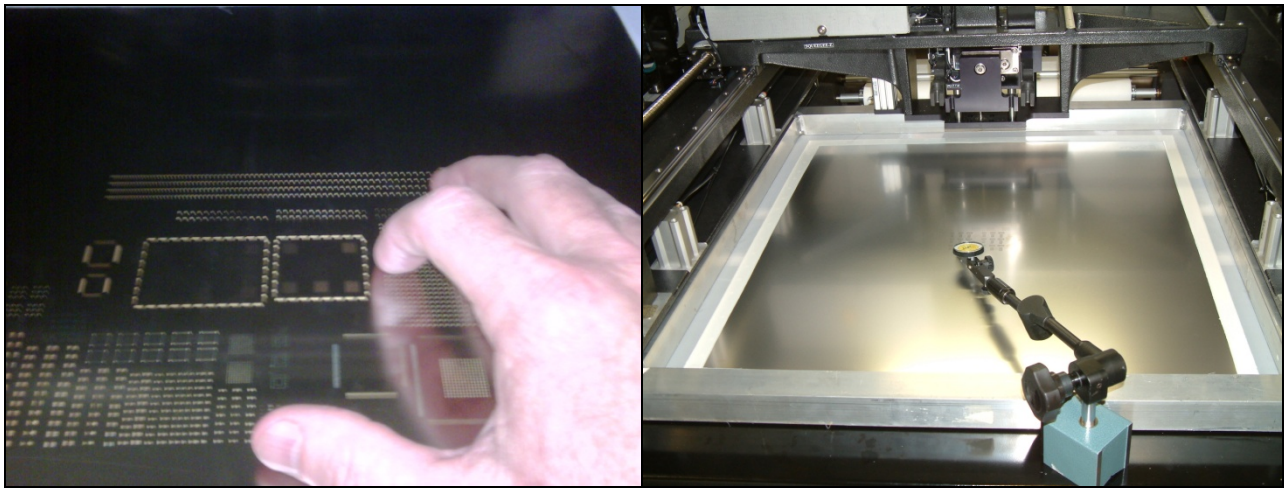
Vacuum Support Tooling is designed to eliminate any solder bleed through Vias and features that are open to both sides of the PCB. Chris Anglin, Indium's Technical Support Engineer, Global Accounts, presented the following finding at IPC APEX 2010 in the paper "Stencil Printing Transfer Efficiency of Circular vs. Square Apertures with the Same Solder Paste Volume." and in a previous paper "Establishing a Precision Stencil Printing Process for Miniaturized Electronics Assembly (IPC APEX 2009).

In the table below, "Squeegee/Stencil/Board Must Be Fully Supported to Control Variation of Transfer Efficiency", Anglin states "…a most understated of best practices in optimizing a solder paste printing process is the importance of printer tooling to stabilize and support the board, and not simply modest board supports but [it is] most important that all printer tooling is completely stabilized during squeegee stroke action". Anglin goes on to add "…it is critical to observe that board and stencil do not move during the time the squeegee rolls the paste over the apertures".

In the next chart Fig. 2 ("Stencil Print-Performance Evaluation Trials"), Anglin shows three methods of board support during screen printing; no support, magnetic pillars or dowels and recessed vacuum box.

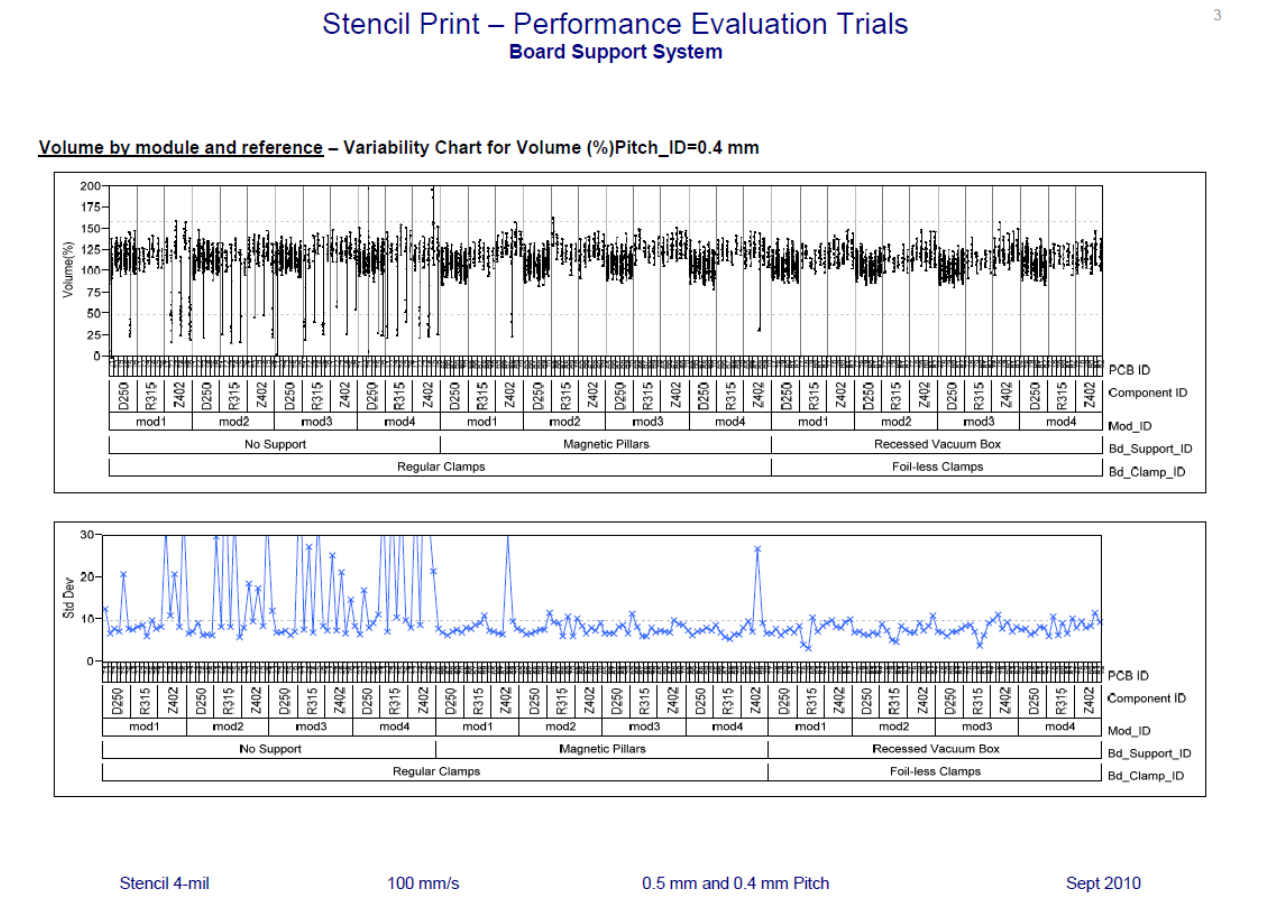
Figure 1.





The cost of the dedicated tooling for high mix/low volume can be demonstrated to be ameliorated when implementation of vacuum support tooling by reduced re-work and higher first pass yields.

Figure 2



Anglin also wrote is an earlier paper, “Establishing a Precision Stencil Printing Process for Miniaturized Electronics Assembly” IPC APEX 2009

“A board support system for stencil printing can offer opportunity for variation in the print performance. Smaller features in the print process will dictate much tighter tolerance for the board support system. Paste print trial performance has shown improvement with routine housekeeping maintenance following and at the start of each print trial. Dedicated support fixtures are custom designed for every print test vehicle. These fixtures provide 100% support coverage of the bottom side of the board. Squeegee length (overhang beyond the edge of the board size) is less than 10 mm, providing maximum support while the squeegee travels over each aperture. The custom support box is vacuum equipped to hold the test board flat and in place.

Minimum squeegee pressure minimizes potential shift in the board position during the print cycle. No print gap is permitted in the print cycle. The printer program is not set to over-compensate the board thickness so that the board is pressed into the stencil causing possible deformation of the flatness of the stencil.”

Additionally, Anglin said,

“Many manufacturers of SMT products may use E-Nickel stencils that range from .004” thick to much greater thicknesses to accommodate BCT (Bottom Connected Terminations, i.e. QFNs).Step stencils are also used. In circumstances that 0.3mm pitch components are near or amidst 01005 components and the assembly has large power devices, copper pads for shielding the challenge for a high yield process are increased and may require dedicated vacuum tooling”.

The solder paste printing process is the greatest challenge and largest opportunity to improve first pass yield and reduce scrap and rework. Removing subjectivity of PCB support placement, repeating the board position in each cycle, extending stencil life and reducing the variable or potential of board movement during the print stroke are all opportunities to improve process and create more profits. The relative cost of dedicated tooling in comparison to the savings of process improvement is straightforward “ROI” analysis.

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