WHAT IS THE NEED FOR VIA HOLES TO BE PLUGGED?

There are a number of reasons why via holes need to be plugged:

• to prevent bridging between closely spaced holes
• to eliminate solder flow up via holes during assembly
• to reduce solder balling
• to minimise flux residues and ionic contamination
• to prevent epoxy resin flowing down holes when encapsulating BGA chips
• and, to create sufficient vacuum during bare board testing, 80% of holes need to be plugged.

DRY FILM V WET FILM AS SOLDER MASKS

Whilst dry film has a 100% success rate with respect to tenting, it’s current usage is restricted by other technical issues such as conductor aspect ratios and SMT. The subsequent switch by the industry to LPISMs has required new Hole Plugging processes to be developed. Hole plugging as a post-operation has a 100% pass rate, and the simultaneous plugging and masking technique results in a 90 – 95% success rate with 0.6 mm via holes.

PROCESSES CURRENTLY BEING USED BY FABRICATORS

In PCB fabrication there are currently five major hole plugging processes being employed. They are:

• prior to LPISM coating
• simultaneously hole plugging whilst LPISM coating
• plugging followed by LPISM coating
• after post-bake (final cure)
• after hot air solder leveling

PROCESS DETAILS

PRIOR TO LPISM COATING

Here there are three types of inks, which may be used. The techniques are to screen print through a stencil where the holes to be plugged are open and the remainder of the screen is filled. Thermal curing 2-pack of single pack resist is printed through the dot stencil, the plugged but uncoated board is then thermally cured at 150°C for 30 mins, then is pumice or brush cleaned to remove excess ink.

Using a U/V curing resist, the same technique, but the ink is U/V cured to 3.5 joules for both sides. Board is then pumice or brush cleaned.

A LPISM may also be used, this is screen printed through an aluminum dot stencil (aluminum stencil assists printing accuracy); the ink is then pre-dried and the board is pumice or brush cleaned.

SIMULTANEOUSLY PLUGGING / LPISM COATING

This technique is particularly applicable to the screen printing process. Use a screen applied LPISM.
Double print the first side through a dot stencil with a 43T mesh. Single print the second side as above, but with a different squeegee pressure to ensure that the holes are plugged. Process as normal for a screen applied LPISM, but the post-bake (final cure) cycle should be staged – 20 minutes @ 100°C, then 60 minutes @ 150°C.

**PLUGGING, FOLLOWED BY LPISM COATING**
The uncoated board is screen printed through an aluminum dot stencil mesh, ensuring that the holes are plugged, but not overfilled. Registration needs to be accurate, or delamination and blistering may occur.

The first side of the board is then curtain / spray coated and pre-dried.

The second side of the board is curtain / spray coated and pre-dried.

The board is then processed as normal using existing parameters for exposure and development.

Post-Bake in a conveyorised oven – set line for 11 zones, with a dwell time of 9 minutes in each zone. 1st zone @ 85°C, 2nd zone @ 95°C, 3rd zone @ 105°C, 4th zone @ 115°C, 5th zone @ 135°C, then the remaining 6 zones @ 155°C. Post-Bake conditions should be optimised at each fabricator.

**AFTER POST BAKE**
Here the board can be retro-plugged, using either a 100% solids UV curing resist, thermal single or two-pack resists, or, where planarity on BGA chips is an issue, use LPISM. Processes as per (a) above omitting brush or pumice clean. Panels after pre-dry need to be developed, to remove excess ink, prior to final post-bake.

**AFTER HASL**
As after Post Bake but do not use LPISM

**PRODUCTS CURRENTLY AVAILABLE**
Listed below are specific products currently available from Coates for the processes described above.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>SALES REFERENCE</th>
<th>PACK CODE</th>
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<tbody>
<tr>
<td>100% Solids U/V Curing Resist</td>
<td>XV1200 Clear</td>
<td>CFSN 6030</td>
</tr>
<tr>
<td>2-pack Thermal Curing Resist</td>
<td>XZ15HP Resist XZ17B Hardener</td>
<td>CKXN 0165 CCSN 3010</td>
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<tr>
<td>Liquid Photoimageable Solder Mask Imagecure®</td>
<td>XV501TPH Resist XV501TPH Hardener</td>
<td>CKXN 0150 CKXN 0151</td>
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**FUTURE DEVELOPMENTS**
There is little doubt that the demand for hole plugging processes will continue to increase. We are happy to say that our current screen-printing and curtain coating products work extremely well, and customers are welcome to discuss their requirements with us at any time.