The Fundamentals of Solder Joint of Solder Joint Design – Part 2 – Surface Mount Solder Joints
SOLDER JOINT CRITERIA

Designed for:

• Electrical conductivity
• Mechanical stability
• Heat dissipation
Review

• Solder joint design criteria
• Requirements of a solder joint
• Know the weaknesses of a solder joint
• What is takes to make a solder joint
• Defined wetting and non-wetting
• Defined the cohesive and adhesive forces
Wetting Angles

θ Greater than 90°

θ Less than 90°
Adhesive Liquid Forces

- Adhesive forces will allow the solder to wet the solid base metal.
- Will create the capillary action up the heel of the lead
- Will allow the solder to spread over the surfaces being soldered
Plated Through Hole Pads

The design is a compromise:

• Board density and minimum electrical spacing require small pads
• Joint strength and reliability require as large a pad as possible
Plated Through Hole Solder Joints

We saw a basic overdesign

• Solder joints had more strength than the board itself

• Double sided PTH joint strength is 8 to 13 times stronger than necessary
Surface Mount Joints

The smt joint is vastly weaker
• Smaller in size
• Less solder in the joint

The SMT joint exhibits a shift from a large PTH to a smaller lap or butt joint, creating a change in the stress distribution as well as the ratio between component weight and solder support.
Rigid Lap Joint

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-13
Rigid Lad
Leadless Chip Carrier

Table 1-10. Comparison Table: LCC Lap vs Pth.

<table>
<thead>
<tr>
<th>SOLDER JOINT</th>
<th>BLIND</th>
<th>LCC LAP</th>
<th>PTH &amp; WIRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length, in.</td>
<td>.04</td>
<td>.04</td>
<td>.032</td>
</tr>
<tr>
<td>Width, in.</td>
<td>.02</td>
<td>.04</td>
<td>.1</td>
</tr>
<tr>
<td>Area, in.²</td>
<td>.0008</td>
<td>.0016</td>
<td>.0082</td>
</tr>
<tr>
<td>% of PTH</td>
<td>9.76</td>
<td>19.51</td>
<td>100.00</td>
</tr>
<tr>
<td>Shear Sn63, lb</td>
<td>4.64</td>
<td>9.28</td>
<td>47.56</td>
</tr>
<tr>
<td>Tensile, lb</td>
<td>6.16</td>
<td>12.32</td>
<td>63.14</td>
</tr>
<tr>
<td>Pad pecl, lb</td>
<td>.2</td>
<td>.4</td>
<td>3.14</td>
</tr>
</tbody>
</table>

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-16
Compliant Lap Joint
Gull Wing

Table 1-8. Comparison Table: SO Lap vs Pth.

<table>
<thead>
<tr>
<th>SOLDER JOINT</th>
<th>SO LAP</th>
<th>PTH/WIRE .032 IN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPICAL MIN AVG. DIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length, in.</td>
<td>.03 .04</td>
<td>.082</td>
</tr>
<tr>
<td>Width, in.</td>
<td>.02 .025</td>
<td>.1</td>
</tr>
<tr>
<td>Area, in.²</td>
<td>.0006 .001</td>
<td>.0082</td>
</tr>
<tr>
<td>% of PTH</td>
<td>7.32 12.20</td>
<td>100.00</td>
</tr>
<tr>
<td>Shear Sn63, lb</td>
<td>3.48 5.8</td>
<td>47.56</td>
</tr>
<tr>
<td>Tensile, lb</td>
<td>4.62 7.7</td>
<td>63.14</td>
</tr>
<tr>
<td>Pad peel, lb</td>
<td>.2 .25</td>
<td>3.14</td>
</tr>
</tbody>
</table>

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-14
Compliant Butt Joint
“J” Lead

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold, Section 1-15
SMT Pad Design

Must take into consideration

• Amount of solder applied to each pad.
• Pad sizes to maintain consistency
• Prevent the application of vias in the areas of the pad
• Recommend review of IPC – 7351 Generic Requirements for Surface Mount Design and Land Pattern Standard
# Comparison of Zones

## Table

<table>
<thead>
<tr>
<th></th>
<th>Range of Shear strength of solder joint, psi</th>
<th>Range of Tensile strength of solder joint, psi</th>
<th>Peel strength of the 1 oz. foil, 1oz = 10psi on FR-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Lap</td>
<td>3.48 – 8.7</td>
<td>4.62 – 11.55</td>
<td>.4 - .5</td>
</tr>
<tr>
<td>LCC</td>
<td>4.64 – 9.28</td>
<td>6.16 – 12.32</td>
<td>.2 - .4</td>
</tr>
<tr>
<td>Gull Wing</td>
<td>3.48 – 5.8</td>
<td>4.62 – 7.7</td>
<td>.2 - .25</td>
</tr>
<tr>
<td>“J” Lead</td>
<td>1.45 – 3.48</td>
<td>1.9 – 4.6</td>
<td>.1 .15</td>
</tr>
</tbody>
</table>

Adapted from Soldering Handbook for Printed Circuits and Surface Mounting, by Howard H. Manko, Van Nostrand Reinhold
Thank You

Questions?
Further Information

Our Next session will discuss questions and answers we’ve provided, it should be interesting and we’re looking forward to your comments.

For questions regarding this webinar, please contact Leo Lambert at leo@eptac.com or call at 800-643-7822 ext 215

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