## Matte Sn Surface Mount Evaluation Summary --- September 2004

The following is a summary of results from the lead free surface mount evaluations performed in coordination with one of the largest surface mount subcontractors in the industry.

The subcontractor provided sections of OSP coated FR4 boards with landing patterns suitable for LTC's 16ld SOICW package. The subcontractor's lead free solder paste of choice had been narrowed down to Sn/3.8Ag/0.7Cu and was compared with their standard 63Sn37Pb paste. LTC dummy devices plated with matte Sn process were provided along with standard SnPb plated packages for the evaluation.

The subcontractor mounted and reflowed the packages, performed inspections, lead pull tests and cross sections. One package per board was mounted. The inspection comments and reflow profiles can be seen on page 2, note the board numbers assigned for each group. End and side photos of the solder joints were taken from one unit for each group and can be seen in pages 3-10. The "as received" pull test results are tabulated in page 15. The matte Sn plated leads performed better than the SnPb plated leads with both solder pastes.

Cross sections of the joints can be seen in pages 11-14. The presence of Pb in the SnAgCu joint can be seen in the cross sections as dark spots (high magnification photos). Note difference in the concentration of these spots between the SnPb and Sn plated leads. The Pb from the plating is dissolved into the SnAgCu paste during reflow. Hence the Sn plated component appears to have considerably less Pb distributed in the SnAgCu joint. As a result, the pure Sn plated parts have a shiny joint and the SnPb plated parts have a dull finish when soldered with the SnAgCu paste.

Several boards from each group were exposed to 1030 temp cycles (–65/+150C), and returned to the subcontractor for lead pull tests and cross sectioning. There was significant degradation in pull strength for all groups (page 16). The matte Sn and the SnPb components soldered with the SnAgCu had equivalent pull strengths. The matte Sn performed better than the SnPb plating when soldered with the standard SnPb paste.

Overall, matte Sn plating formed as good or better joints with both of the subcontractor's pastes as the standard SnPb plating.

**Linear Technology evaluation**

| **OSP coated FR4 board**<br>**SOL16 components** | **SnAgCu paste**<br>**Sn component**<br>Board Nos. 1-13 | **SnAgCu paste**<br>**SnPb component**<br>Boards No. 14- 26 | **SnPb paste**<br>**Sn component**<br>Board Nos. 27-40 | **SnPb paste**<br>**SnPb component**<br>Board Nos. 41-51 |
|---|---|---|---|---|
| **Comments** | Board Nos. 2 and 8<br>have defects(Do not use)<br>All shiny joints | Dull appearance of solder joints | Board No. 31<br>has defects(Do not use)<br>All shiny joints | <br><br>All shiny joints |

| Component reflow profiles | **Peak temp/°C** | **Time above 183°C** | **Time above 217°C** |
|---|---|---|---|
| **SnPb paste profile** | 215°C | 60 secs | |
| **SnAgCu paste profile** | 245-247°C | | 61-65secs |

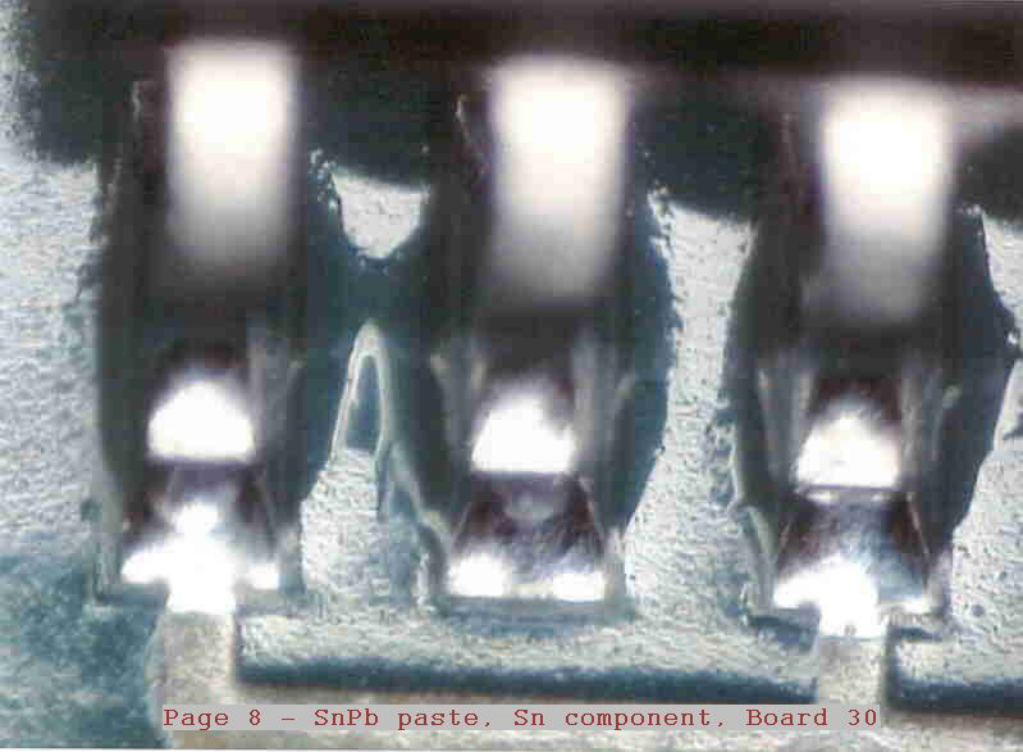
Page 3 - SnAgCu paste, Sn component, Board 5


Page 4 - SnAgCu paste, Sn component, Board 5

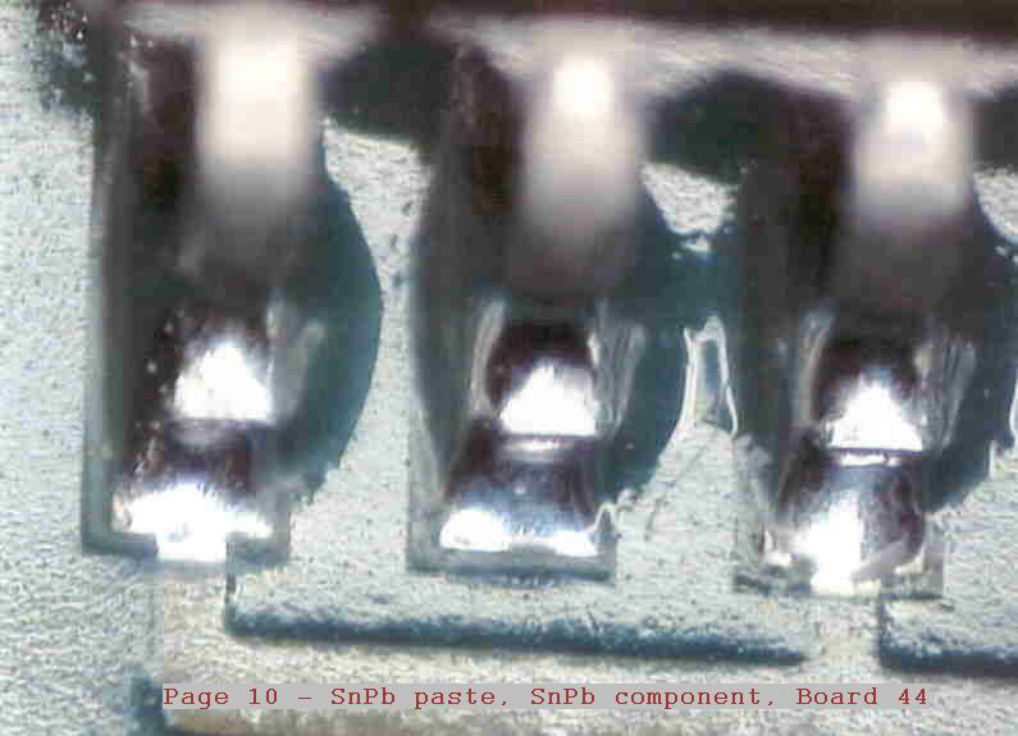
Page 5 - SnAgCu paste, SnPb component, Board 17

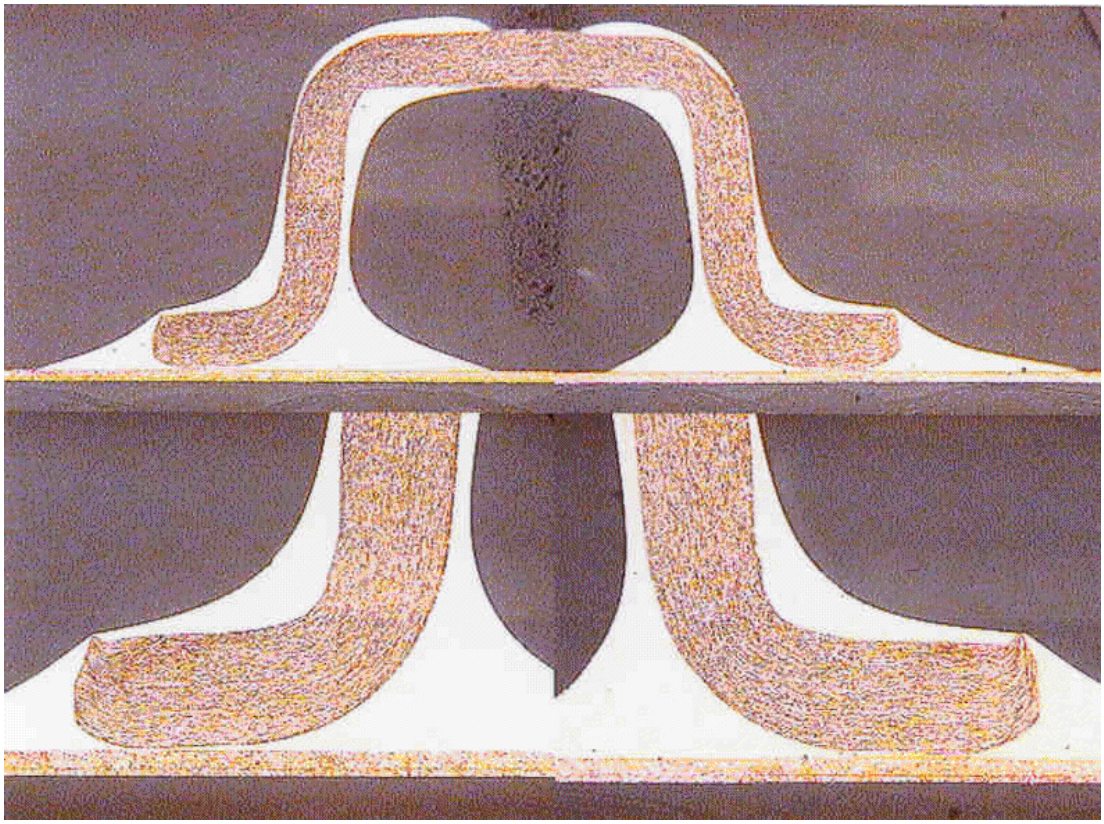
Page 6 - SnAgCu paste, SnPb component, Board 17

Page 7 - SnPb paste, Sn component, Board 30

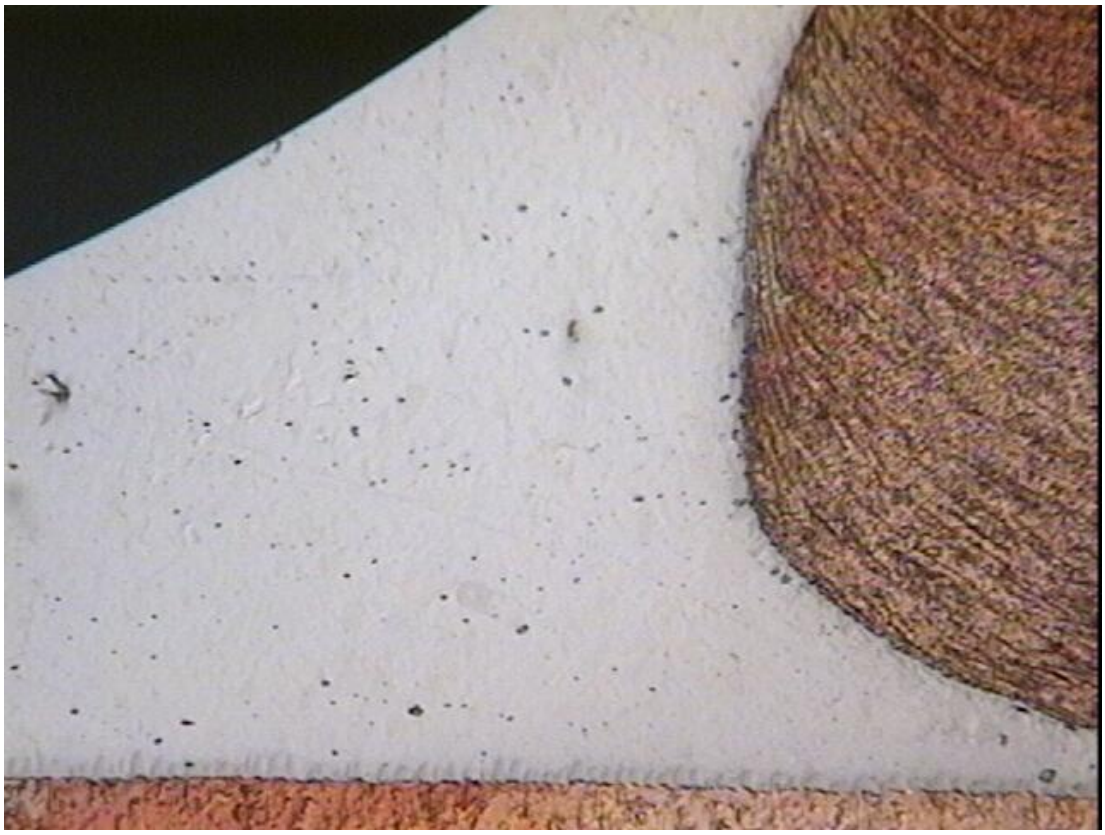



Page 9 - SnPb paste, SnPb component, Board 44

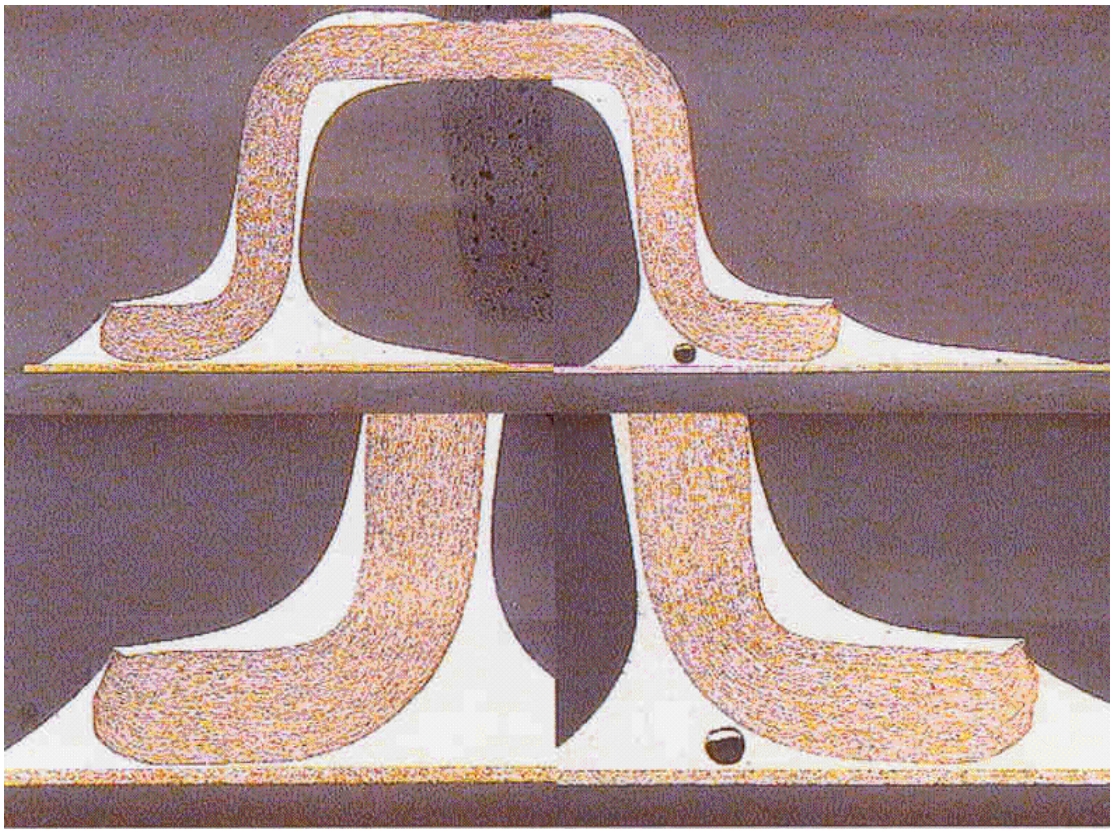




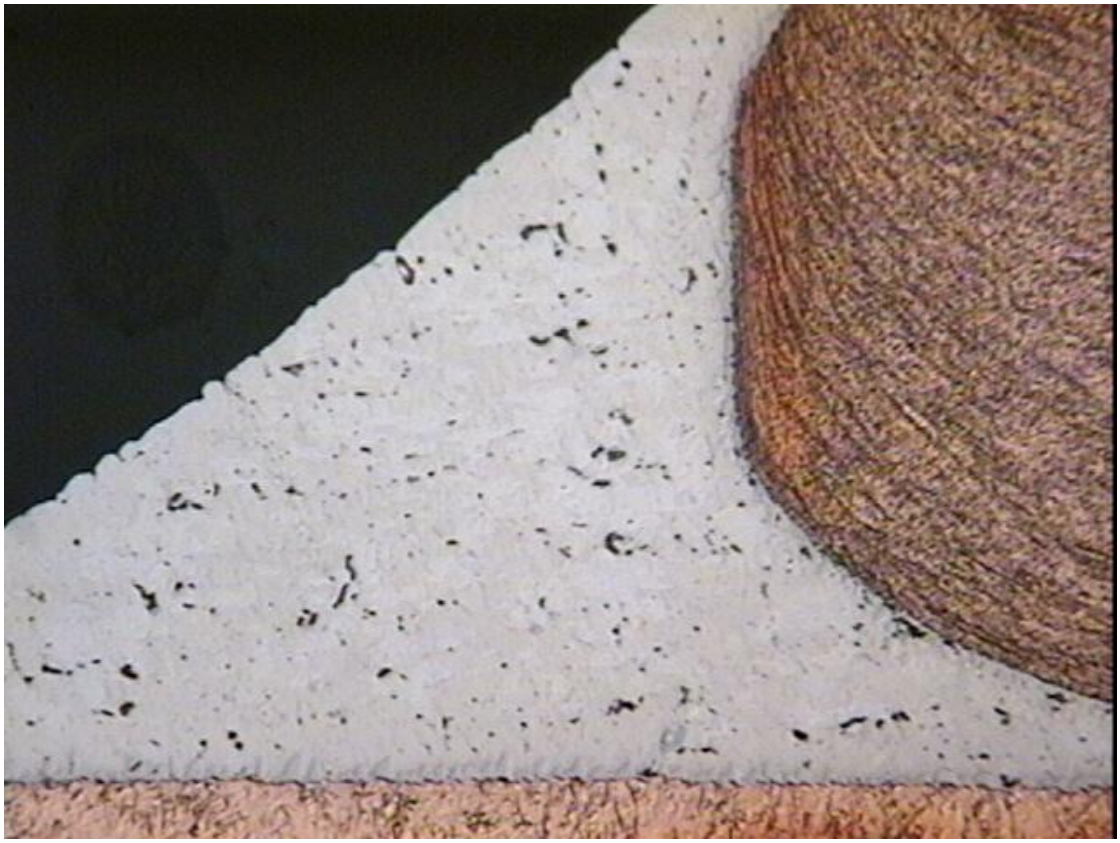
Board 3 SnAgCu paste, Sn component (As-received)



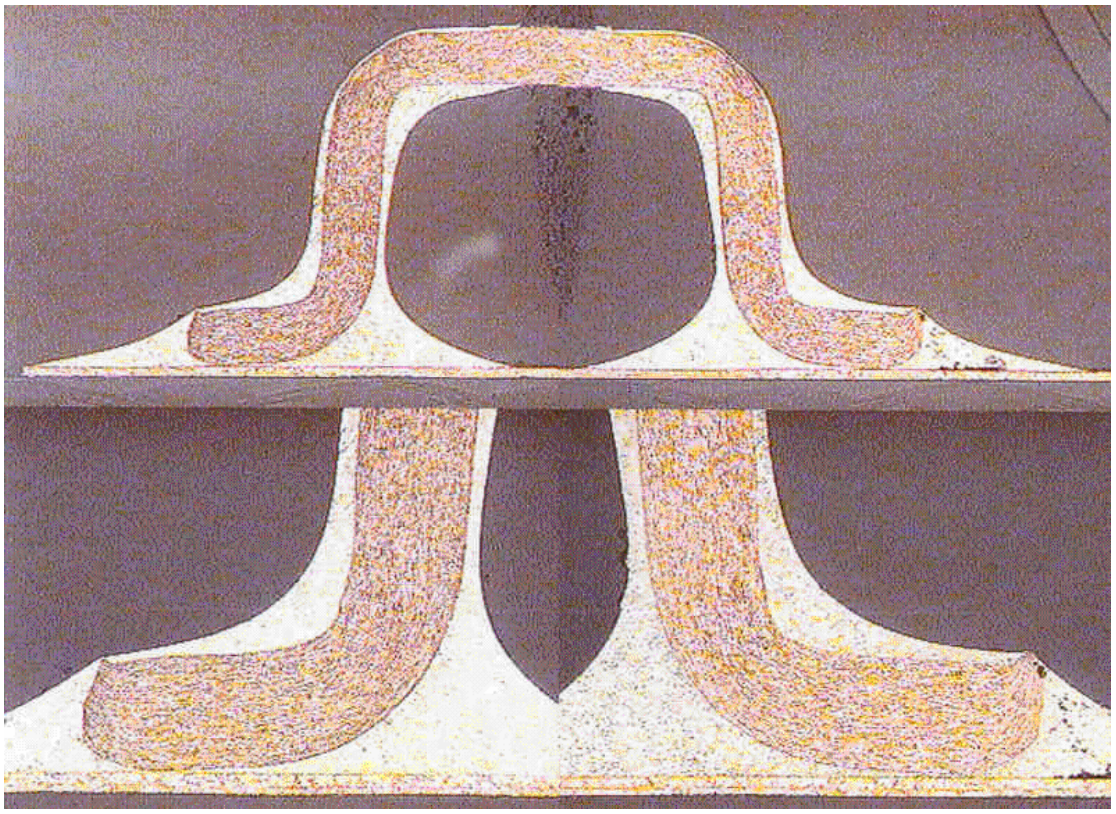
750-3 SOIC-A (SnAgCu paste, Sn component) 500X



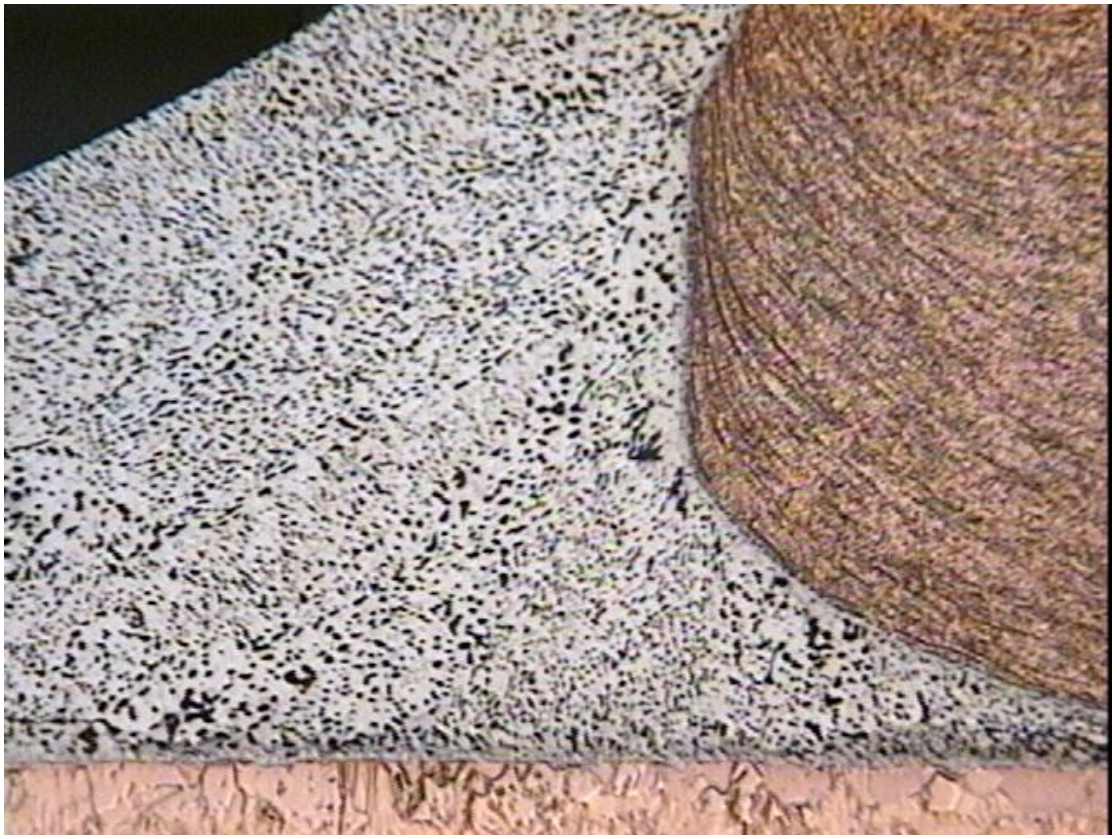
Board 14 SnAgCu paste, SnPb component (As-received)



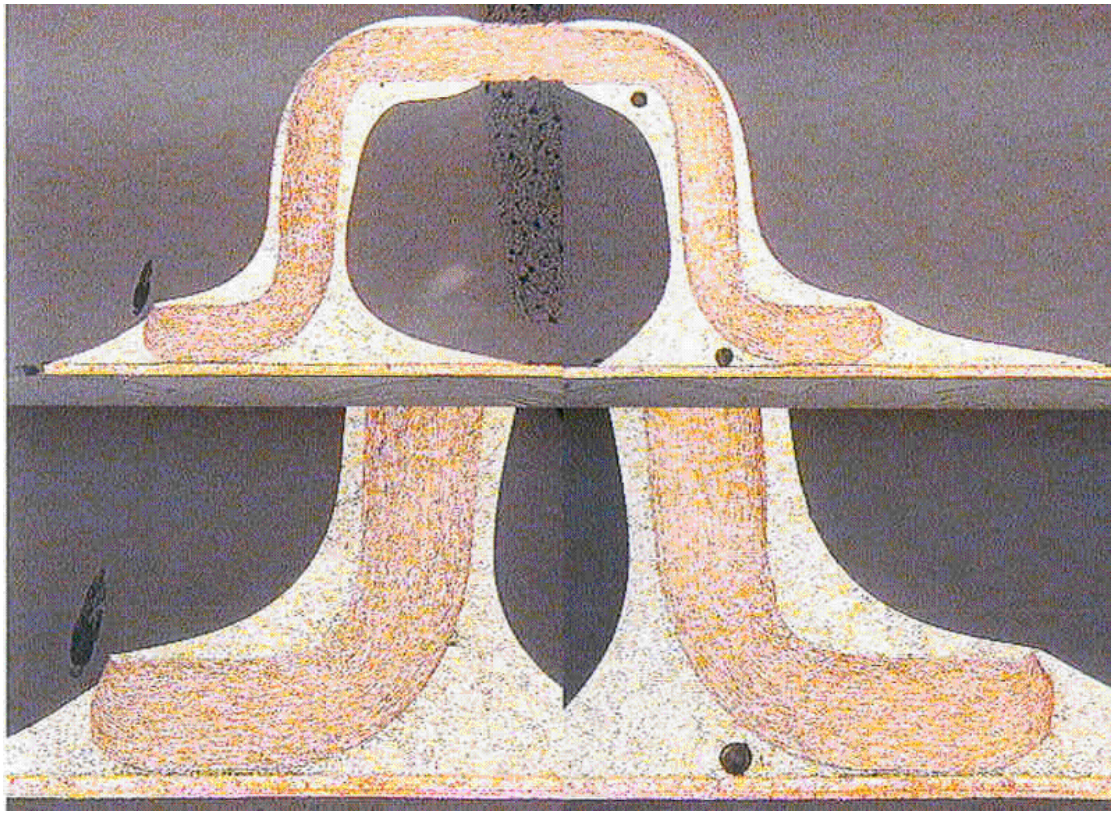
750-14 SOIC-A (SnAgCu paste, SnPb component) 500X



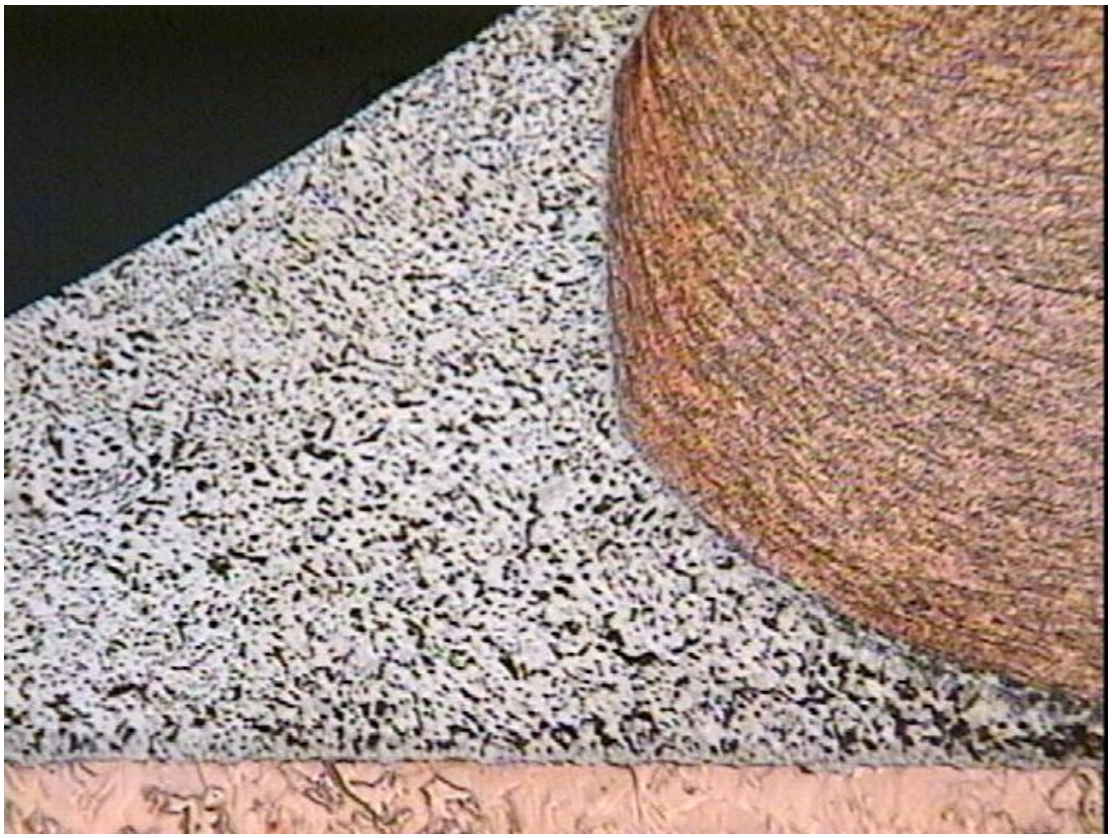
Board 27 SnPb paste, Sn component (As-received)



750-27 SOIC-A (SnPb paste, Sn component) 500X



Board 41 SnPb paste, SnPb component (As-received)



750-41 SOIC-A (SnPb paste, SnPb component) 500X

| As received | FA-750 Test Vehicle | | | |
|---|---|---|---|---|
| **Pull Test Number** | **Board #4** | **Board #15** | **Board #28** | **Board #42** |
| lb force(SOL 16 50mil pitch) | SnAgCu paste | SnAgCu paste | SnPb paste | SnPb paste |
| 0.5inch/min crosshead speed | Sn component | SnPb component | Sn component | SnPb component |
| **1** | **7.8** | **5.2** | **6.6** | **7** |
| **2** | **7.8** | **5.4** | **7.6** | **6.6** |
| **3** | **8.4** | **5.6** | **7.8** | **7.4** |
| **4** | **8** | **6.4** | **7.8** | **7** |
| **5** | **8.2** | **7** | **8.2** | **6.6** |
| **6** | **7.6** | **6.8** | **7.6** | **6.6** |
| **7** | **7.2** | **6.2** | **7.4** | **6.6** |
| **8** | **7** | **5** | **7.4** | **6.6** |
| **9** | **7** | **6.8** | **8** | **6.6** |
| **10** | **7.6** | **6.8** | **8** | **7** |
| **11** | **7.6** | **5** | **8** | **6.8** |
| **12** | **7.8** | **4.2** | **7.6** | **7** |
| **13** | **8.4** | **6.4** | **7.4** | **6.8** |
| **14** | **8.6** | **6** | **6.6** | **7.6** |
| **15** | **7.8** | **7.4** | **7.2** | **6.2** |
| **16** | **7.8** | **4.2** | **6.4** | **6.2** |
| Average | **7.8** | **5.9** | **7.5** | **6.8** |
| Stdev | 0.5 | 1.0 | 0.5 | 0.4 |
| Min | 7.0 | 4.2 | 6.4 | 6.2 |
| Max | 8.6 | 7.4 | 8.2 | 7.6 |

| | SnAgCu paste/ Sn comp | SnAgCu paste/ SnPb comp | SnPb paste/ Sn comp | SnPb paste/SnPb comp |
|---|---|---|---|---|
| As-received | 7.8 | 5.9 | 7.5 | 6.8 |
| Stdev As-received | 0.5 | 1.0 | 0.5 | 0.4 |
| Aged | 3.1 | 3.2 | 5.2 | 4.0 |
| Stdev Aged | 0.5 | 0.5 | 1.1 | 1.0 |