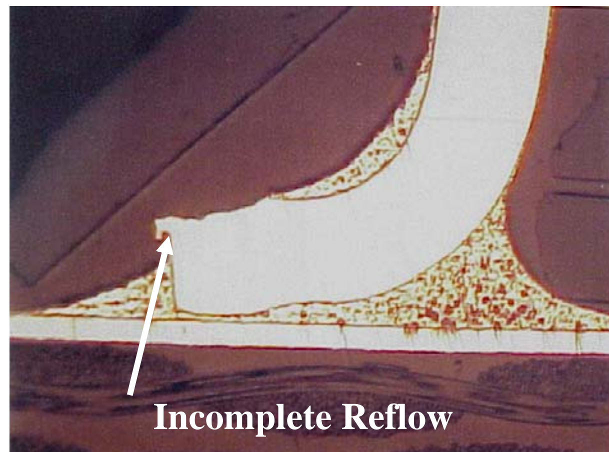
FORESITE
ISO 9001:2000 Certified

Solderability Problems: Both Residue and Thermal Conditions

Higher thermal mass boards require close examination of soldering profiles and solder deposition

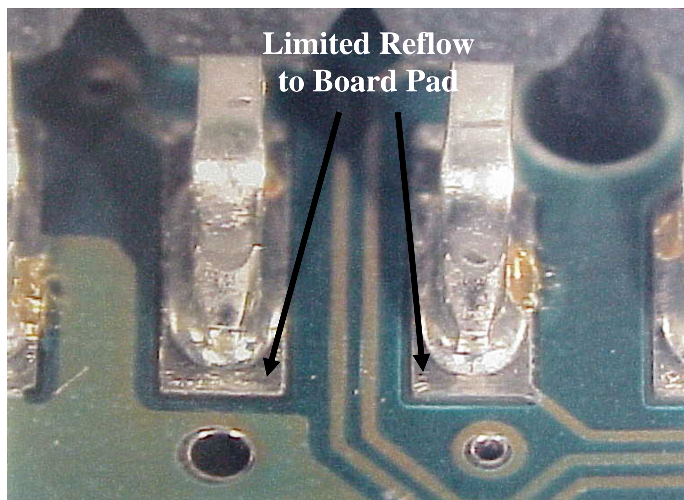
Foresite Inc.

Even under normal thermal profiling, certain large mass connectors require additional heat and time above liquidous. In this case study, we will investigate whether residues had any effect on poor soldering performance. Using both ion chromatography and cross sectional investigative techniques, we were able to understand the processing effects. If solder is not allowed to stay liquidous for the appropriate amount of time required by the mass of the assembly, several critical issues can arise. Two of the major issues encountered by the customer highlighted in this study were weakened solder bonds and flux residues that were not fully volatilized. As a result of these issues, solder bonds were easily breaking, and harmful ionic residues were left on the assemblies and could cause electrical failures.



Cross Section of SOIC Termination

The customer examined in this study was having trouble with connector contacts to headers after reflow soldering on a densely populated assembly. The connector contacts to the headers would come easily detached, and solder was left both on the board and the header. Our investigation of this issue involved both ion chromatography with localized C3 extraction and cross sectional analysis. Localized ion chromatography results of the failure areas on the board showed higher than preferable amounts of chloride and weak organic acid residues. These residues were most likely attributed to flux not being able to completely complex and volatilize due to insufficient heating in the soldering profile for the density of this assembly. If these residues are left on the board without being volatilized, they pose a risk of electromigration or electrical leakage failure.



Condition of Header Reflow (Top Side) (Typical) Note: Flux Residue

Cross sectional analysis of these assemblies showed incomplete solder reflow, poor wetting conditions and non-homogenous alloy structures. Multiple apexes in the solder profile showed that solder was still in the process of wetting when heat was removed, allowing for the solder's surface to be pulled under a high degree of tension, and creating high wetting angles. Flux bubbles and spherical formations of insufficiently reflowed solder were also seen. These conditions were all exaggerated around the larger components such as the failed headers.

1982 S. Elizabeth St. • Kokomo, IN 46902 • 765.457.8095 • www.residues.com • ForesiteInfo@residues.com

ISO 9001:2000 Certified

After examining all of these results and taking into account the characteristics of this assembly, we made several recommendations. First, we recommended testing bare boards for solderability to see if the added mass of the components created a need for greater thermal energy to be applied during reflow. We also suggested examining solder deposition thickness to see if the appropriate volume of solder is being applied to the boards. Finally, we suggested examining the general reflow soldering profile to see if temperatures were high enough and applied long enough for the solder to become eutectic and form good intermetallic bonds.

The customer took these recommendations into account, and we tested bare boards for solderability. These samples saw much better solder joints, more homogenous alloy structures and fewer anomalies such as flux bubbles containing ionic residues. Following this analysis, the customer altered the soldering profile to accommodate for the added mass of componentry, and saw much better results in solder bond strength and quality.

The key to solving this problem was making certain that the soldering profile matched the characteristics of this highly populated assembly. By making sure enough heat was applied for the appropriate amount of time required for the density of this assembly, effective reflow conditions were seen, and appropriate volatilization of flux residues was achieved.

Data Table

Sample Description	Ion Chromatography		
	Cl^-	Br^-	WOA
C3 Extraction			
Header Area (top failure locatoin)	86.60	0.00	75.50
Residue Area (back)	5.43	0.00	35.70
Reference Area (back)	10.60	0.00	16.40
Standard Extraction			
Assembly Extraction #1	24.40	1.45	2.19
Assembly Extraction #2	7.60	0.51	61.90

NOTE: All values in $\mu g/in^2$, unless otherwise noted.

1982 S. Elizabeth St. • Kokomo, IN 46902 • 765.457.8095 • www.residues.com • ForesiteInfo@residues.com