



What, Me Worry About Fumes? Switches mysteriously lose contact.

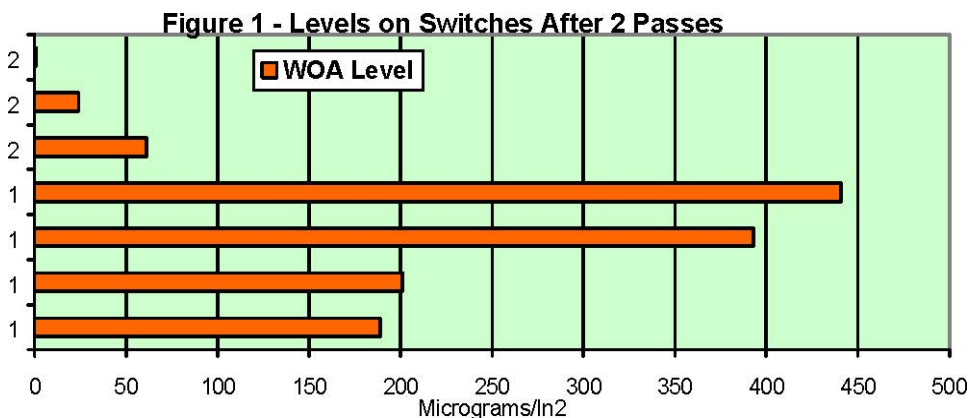
Low solids fluxes are finding increasing usage around the world. The cost savings afforded by the elimination of the cleaning operation are often attractive but the world of no-clean fluxes holds many dangers for the uninformed. Changing from a high solids flux and cleaning to a low solids flux and no cleaning involves adjusting to new materials and characteristics.

The assembler was a mobile phones manufacturer. The product incorporated momentary contact switches (the phone buttons) into the printed wiring assembly. Two solder paste deposition steps and two reflow operations were used with hand soldering of some switches. Hand soldering included the use of a liquid low solids flux. The momentary switches were in place during one of the paste reflow processes and during the touch up soldering. If there was a solder paste misprint, the solder paste was removed with isopropanol and a large brush (a rather crude process). The assembler began to see intermittent contact problems with the switches worked fine during the four quality checks. Both developed intermittent contact problems after storage for several days in high humidity conditions.

In analyzing the failure problem, there were two possibilities to consider:

- The switches were bad from the start, from either poor metal plating (silver) or the formation of oxide layer.
- The switches acquired a barrier film at some point in the process.

Ion chromatography (IC) showed no halide or other ionic contaminants on a sampling of the switches in as-received condition. Scanning Electron Microscope (SEM) work showed good plated contacts in the new switches and no signs of barrier films. We concluded that the incoming switches were acceptable and that something in the assembly process was amiss. The faulty switches all had a slight discoloration in the inner metal surfaces, indicative of a residue. At the time of the analysis the assembler was phasing out to the process of adding liquid flux during hand solder operations. Both processes (with and without liquid fluxes) were analyzed. Figure 1 shows the results of the IC analysis.



- High levels of weak organic acids (flux residues) were found on the inner surface of the switch bodies when the liquid flux was used.
- Lower levels of WOAs were present when the liquid flux was not used.



The analysis showed the liquid no-clean flux was somehow getting inside the switch. The isopropanol-carried flux has a very low surface tension. Capillary action had drawn the liquid flux up from the board surface (low standoff). For the switches that had not been exposed to the liquid flux, WOAs from the cored wire solder were volatilized during the hand solder operations and re-deposited themselves on the inner surfaces of the switch. The WOA-rich fumes were as pervasive as the liquid flux but lower in concentration. The variable nature of a fume deposit made the presence or absence of WOAs variable likewise leading to intermittent faults. During the quality checks of the shop floor, contacts were acceptable because the WOAs either had some residual isopropanol improving contact or the fume-deposited WOA layers were very thin, allowing operator finger pressure to displace the film. After several days of storage, the switches either lost the residual isopropanol and hardened into a solid film or the WOAs absorbed water from the atmosphere, swelling the film and interfering with contact. Humidity had been unusually high in the region of the country during testing. WOAs are seldom conductive materials.

The assembler eliminated the use of the liquid flux during hand soldering operations.

Fume extraction techniques were implemented during hand soldering.

Conclusion

Most fluxes are isopropanol carried. The low surface tension takes the flux to places you thought were highly unlikely. For a water-soluble flux, this means that you can get corrosive residues in places that are impossible to clean with conventional methods. We tend to ignore flux residues when we feel that they have been driven from the board surface during reflow. It should be remembered that the fumes during reflow contain evaporated and pyrolyzed elements and will re-deposit on the nearest surface in the absence of special measures.