Defects – Parts Per Part

Inefficient Flux dispersal and poor equipment maintenance
led to solder quality issues
Foresite Inc.

We love site visits. It gets us out of the everyday routine and exposes us to different cultures. While we normally concentrate on residue or contamination issues, we occasionally assess other areas as well, such as solder defects.

The customer in this case was 'south of the border', manufacturing commercial / consumer products using a low solids flux wave solder process and no post-reflow cleaning. In some of the early work in assessing the assembly cleanliness, we noted many solder quality issues, such as:

- Bridging of two or more solder joint areas
- Skips (areas of no solder)
- Icicles on long leads
- Solder balls
- A frosted appearance on the solder joints

In a visit to the site, we noted the following:

- A spray fluxer using an isopropanol-based low solids flux, with excessive overspray. The spray fluxer was mounted directly on the rails.
- A belt speed of 5.0 feet per minute
- A single wave on an old Electrovert Ultrapak – 63/37 solder set at 500ºF. The interior walls were coated with flux.
- Dross production of 2-3 pounds per day
- A huge amount of flux consumed each day
- No thermal profiling (nor knowledge of what this was)
- Nearly non-existent maintenance
- Defect rates in excess of 500 ppm
- Portions of the board did not contact the wave

A close examination of the fluxer setup showed some portions of the board dripping wet with flux, and other areas dry. We loaded the solder pallets with thermal paper (from a thermal fax machine) and ran them through the fluxer. Some portions of the paper were saturated with at least a 50% overlap in the spray pattern. Some portions of the paper were dry. Many of the defects were found in the areas of the boards that were dry. Virtually every pallet of boards had defect areas in the non-fluxed portions and the assemblies automatically went to hand soldering.

A few days of intensive work on the system followed. We changed the following:

- The oscillating nature of the spray fluxer also oscillated (shook) the rails of the wave solder machine, sometimes physically lifting a portion of the assembly off the wave solder. A free-standing base was made, rather than hanging the fluxer from the rails.
- The distance from the spray nozzles to the boards was decreased by one inch. This served to decrease the overlap area.
- A stainless steel guard was created to minimize outside air flow on the spray fluxer stream. Outside air currents were significant and tended to blow the flux everywhere except onto the board.

- The travel of the heads was corrected so that the whole pallet area received equal flux treatment. Mylar film was used in the pallets, checking weights before and (two minutes) after, in order to determine the amount of applied flux and the consistency of flux application.
- Implemented nozzle cleaning on the spray fluxer 2-3 times per shift.
- Reduced the spray pressure, spray volume, and amount of overlap
- The preheats were optimized (lower) for the flux used and the personnel trained on thermal profiling
- Designed new pallets that made flux application, preheat, and soldering more efficient. Regularly clean the pallets with saponified water.
- Wave solder angle was changed from 5 degrees to 7-9 degrees and replaced a damaged wave gate. The rails were lowered to give a better contact depth.

The end result was a drop in solder defect rates in excess of 500 ppm to rates of 20 ppm, with lower rates envisioned as more process work is done.

Lest we be too quick to ascribe such a situation to the local culture or local education level, you would be stunned at how often this situation occurs in the U.S. as well.