I just Can't Win!

Doing everything right, & still failing qual testing?

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This assembler was examining different combinations of conformal coatings and OA fluxes, using the qualification guidelines of MIL-STD-2000A; Appendix A. The assembler had good experiences with the water-soluble solder paste and no noted problems with conformal coating application. As was prudent, the assembler pre-cleaned and dried all of the B-36 standard test assemblies to ensure that any pre-existing residues were removed prior to processing with the water-soluble pastes. The boards were assembled using the candidate process, reflowed and aqueous cleaned. Patterns 2 and 4 on the boards were checked with a multimeter. No low resistance paths (i.e. shorts) were found. The conformal coatings were spray applied, with a cure cycle after each application. One of the coatings was a UV-curable 100% solids acrylic and the other was a solvent-borne thermal cure coating. The coating was applied in a manner acceptable for military guidelines. In theory, the test boards should have passed the testing with ease.

The initial measurements for surface insulation resistance (SIR) testing showed a wide range of resistance values for the ten test patterns on a B-36 assembly. In general, all initial resistances should be higher than 10^{10} ohms. Values lower than this may be indicative of entrapped water from a cleaning operation or some conductive residue. The observed values ranged anywhere from 10^{8} ohms (100 megohm) to 10^{12} ohms. The low values were not attributed to any one test pattern, but always occurred on a pattern under a leadless chip carrier (LCC). During the ten day cyclical temperature - humidity testing, measured resistances were in the 10^{6} ohm (1 megohm) to 10^{9} ohm (1000 megohm), with enough low resistance points to cause all combinations of flux and conformal coating to fail the test.

A prudent practice, implemented in J-STD-001A but not in the older MIL-STD-2000A, is to do a visual examination of the B-36 boards following SIR testing. In such an examination, the LCCs are removed to examine the patterns beneath. Our preferred method of removing LCCs is with a sharp chisel under one corner and one sharp rap with a mallet. With some practice (and we have had lots of practice), this can be done with minimal damage to the boards or test patterns. It is somewhat hard on the LCCs and the chisel though. The boards were examined using light incident from the top, which is best used to show surface corrosion, and using light incident from behind the board (back lighting), which is best used to show instances of metal migration.

We found a clear material that had filled portions of the space between the LCC and the B-36 board that matched the characteristics of the conformal coating. Sometimes there was a large amount of the material under the LCC, and sometimes a sparing amount. In no instance did we see signs of corrosion or metal migration.

The clear material was conformal coating. The isopropanol carrier had pulled the coating under the LCC (by capillary action), where it was shielded from UV light and most thermal effects. The outer portions of the coating cured first, entrapping solvents and uncured or partially cured coating. Polymer mixtures, which are not completely polymerized or which contain solvent, gave the poor SIR performance noted. The customer was advised of the phenomena and modified the coating and curing procedures to avoid this problem.