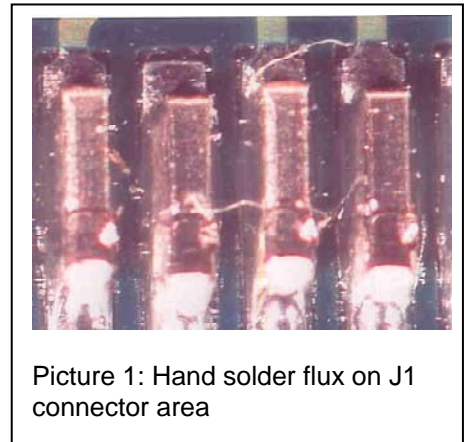


CAN YOU CLEAN A NO CLEAN ASSEMBLY?

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Case Study

Recently, a client experienced a high percentage of product returns from the field, but on closer examination, many of the boards were functionally good at the test bench. These No Trouble Found (NTF's) returns were a major increase over previous products and occurred during the spring and summer here in the United States. The assembly process was a mixed assembly with a hand soldered connector on the wave solder side of the assembly. A low solids no clean paste, wave flux, and cored solder were used on the assembly and qualified with standard SIR testing. Product built during the product validation process also performed well during the ESS testing. Now, eight months into the production cycle, boards with less than 60 days of use in the field are experiencing a high percentage of intermittent problems in the field. SEM and EDX analysis were inconclusive as to the root cause of the failure.



Upon initial investigation "Nothing Changed", board vendor and processes, flux, paste, cored solder, thermal profiles, equipment all were as they were at the time of the qualification. Visually, all the assemblies showed no differences that could be identified by trained visual inspectors and instructors. Cleanliness testing on the production floor consistently showed low levels of NaCl equivalents (<6.0). So what was the cause?

Our investigation of the failures was a direct comparison of the field returns and the current production samples. We also checked the cleanliness of the incoming bare boards and the components that seem to be part of each of the failure circuits (0805 resistors, and connector).

Our findings when using Ion Chromatography were as follows:

The data shows us that the failed assemblies and current production samples were similarly high in chloride and Weak Organic Acids (WOA) values. The high chloride came from the bare board HASL fluxes and cleaning processes. The connector and resistors were ionically clean and not the source of the contamination. The

Ion Chromatography Results

Sample Description	Board location	Chloride (µg/in ²)	Bromide (µg/in ²)	Sulfate (µg/in ²)	WOA s (µg/in ²)
Failed Assembly	J1 area	8.71	3.36	0.0	169.87
Failed Assembly	J1 area	7.39	3.09	0.0	194.36
Current Production	J1 area	8.48	3.24	0.0	204.71
Current Production	J1 area	8.04	3.16	0.0	139.54
Current without J1 Hand soldering	J1 area	7.49	2.71	0.0	91.39
Current without J1 Hand soldering	J1 area	7.11	2.46	0.0	107.42
Bare Board	J1 area	7.90	1.25	0.23	0.0
0805 Resistor	New	1.21	0.0	0.18	0.0
Connectors	New	0.26	0.0	0.39	0.0
Cleaned with water	J1 area	8.76	3.65	0.0	179.74
Cleaned with Saponifier / Steam	J1 area	1.33	1.39	0.0	27.36

boards without the hand soldering of the J1 connector showed a much lower level of WOA. The hand soldering process used extra wave solder flux for soldering the connector. These are hazy and clear residues visually between the contact leads of the hand soldered connector. The extra flux residue between leads on the connector was not heat activated, and is moisture absorbing and conductive. The partially reacted flux residue and high chloride levels from the bare board fabrication process create a product that will continue to have intermittent performance problems until enough moisture is absorbed and hard electromigration failures occur.

Now that we know the root cause of the NTF problems, the question is “Can we clean a No Clean?” We have seen with water only, as seen in the next photo (Photo #2), a thicker white haze is formed between the connector leads and heavy white residue is seen between leads on the board surface (see Photo #3). Cleaning with water only showed no reduction in the residues and a heavy visible flux residue. Cleaning was only effective when a saponifier was used at low pressure at 140 F wash temperature, then rinsed with steam and DI water. The data shows that the board fabrication and WOA residues have been greatly reduced (below our recommended limits) and that functional testing of the **Saponified / Steam cleaned** assembly showed great product performance (10 of 10 cleaned boards passed) even after 16 hours of 40 C/ 90% RH. Control **not cleaned** assemblies were also exposed to these environmental conditions (both groups without bias, just exposure) and tested (9 of 10 not cleaned). They failed due to stray voltage and leakage.

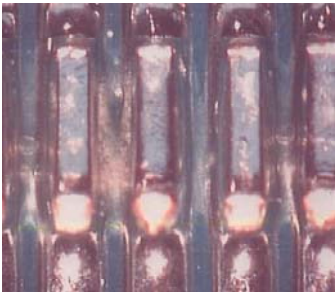


Photo #2 J1 Connector after water wash at 140 F

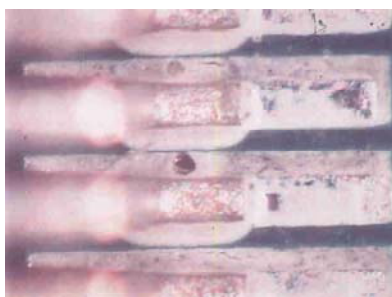


Photo #3 U301 leads after water wash at 140 F

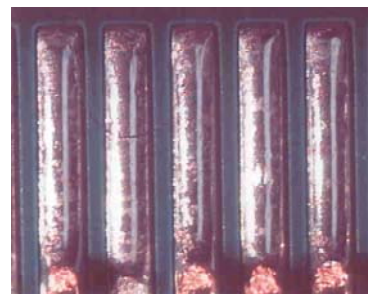


Photo #4 – J1 Connector after low Pressure Saponified (EnviroGold 816) with Steam Rinsing (PDQ)

Conclusions

Heavy partially reacted Low Solids no clean fluxes can cause electrical performance problems (a large percentage of the NTF today may be caused by residues) by absorbing moisture from and creating a conductive path on sensitive circuitry. Cleaning with a saponifier and steam with low pressure on the entire assembly can remove the moisture absorbing flux and even clean fabrication residues that may cause long term reliability risks. So, YES you can clean a No Clean!