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It Always Works for the Repairman

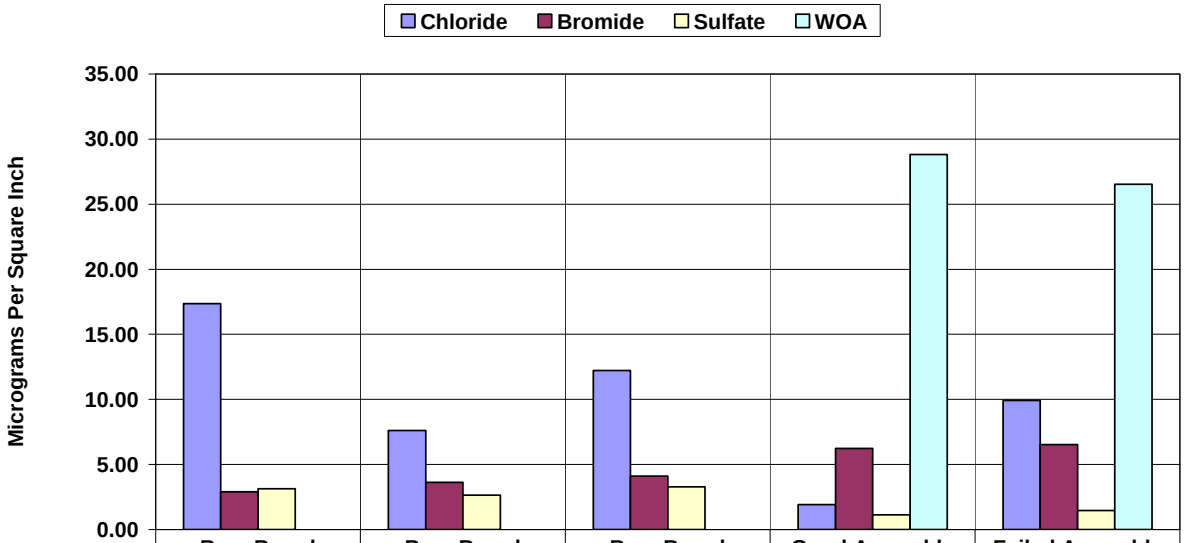
NTF returns are often the result of an absence of moisture

Foresite Inc.

One of Murphy's Laws says that any broken appliance will always work when demonstrated for the repairman. The corollary in the electronics assembly would involve a returned assembly and the bench technician. In many cases, an electronic assembly will be returned from the field with the diagnosis of unacceptable performance (or no performance). When the bench tech sets up the suspect assembly, it works just fine and the assembly is usually returned to the customer with the label of NTF – No Trouble Found. This occurrence is more frequent than most any assembler would care to admit. The biggest underlying reason for the NTFs is relative humidity and contamination. In the field, humidity runs fairly high (come to Indiana some August). When the assembly is tested in the 25°C / 50% RH environment of a rework/repair facility, the problem cannot be duplicated. This month's study is one such problem, illustrating the effects of humidity on bench troubleshooting.

The assembly in question went into an automotive (in cab/trunk) application, which can be a hostile environment. The problem area was a SOT-23 package. The assembly containing this area was returned by the automotive manufacturer for improper function. When the bench technician isolated the SOT-23 area as the problem area, the voltage was monitored between the solder pad on the left and the upper solder pad on the right. The voltage should have been 0.00 volts, but was not (~1.4V). The assembler placed the assembly into accelerated temperature-humidity (60°C/90% RH) environment. Past testing showed that a good assembly should pass 168 powered hours in this environment. The assembly failed after less than 96 hours. When removed from the chamber, the failure mechanism (stray leakage) stayed for days, registering 1.4 volts. The assembly was put into an ESD bag and sent to us for analysis. Chart #1 shows the contamination levels in the SOT-23 area. After the ion chromatography extraction, the assembly was returned to the bench technician. No voltage registered when tested. The failure mechanism was gone. The extracted assembly was put into the accelerated temperature-humidity test and this time performed acceptably.

Chart 1 - Residue Levels



	Bare Board	Bare Board	Bare Board	Good Assembly	Failed Assembly
Chloride	17.36	7.62	12.22	1.92	9.92
Bromide	2.91	3.64	4.11	6.23	6.54
Sulfate	3.14	2.65	3.29	1.13	1.47
WOA	0.00	0.00	0.00	28.81	26.53

Tested Item

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The problem was two-fold. The bare boards for this assembly had very high chloride and polyglycol residues. As a reference, we recommend chloride levels of less than 2.0 micrograms per square inch for bare boards. High levels of ionic residues contribute to electrical leakage currents and to electromigration. The second contributor is often a polyglycol residue, remaining after hot air solder leveling (HASL). Polyglycols are used as the carrier solutions in many HASL fluxes or fusing fluids and serve to attract water, which gives the HASL fluxes some water soluble characteristics. While ion chromatography does not directly measure polyglycols, their presence is often implied when bare board chloride or bromide residues are high. If you didn't clean the halides, you didn't get all the polyglycols either. For an assembly, this means that the presence of polyglycols makes the assembly very sensitive to moisture. The SOT-23 area was contaminated in this manner. The polyglycols attracted the moisture from the environment, initiating the leakage currents. Sometimes just breathing on the suspect area supplies enough moisture to create the failure. After the extraction, neither the polyglycol nor the halides were present to cause the leakage currents.

The next time an assembly fails to exhibit the same electrical leakage modes as found in the field, consider testing the assembly in a higher humidity (90%+) environment, before labeling as a NTF. The next step would be to identify the type and level of ionic contamination present and the source of the contamination as part of a Corrective Action Plan.