TECHtips

Electronics Manufacturing Insights from ACI Technologies, Inc.

Identifying Flux Residues

Why identify flux residues? The primary purpose of flux is to reduce species of metal oxides from solderable surfaces, and to act as a mechanism for lifting and removing debris. If the assembly is not properly cleaned after manufacturing, flux may continue to reduce metals and may eventually corrode the assembly. When the assembly is powered, the metal ions may precipitate along electromagnetic field lines and form dendritic shorts. In addition, the presence of residue can alter the insulation properties of a board, affect the adhesion of the conformal coating, or interfere with the moving parts of the assembly. In radio frequency (RF) applications, flux may change the RF properties on the surface of the printed circuit board (PCB) such as the dielectric strength, surface resistance, and Q-resonance.

Different flux chemistries require different cleaning chemistries (Figure 1). Identifying the presence, amount, and type of flux residues helps the manufacturing engineer judge the effectiveness of the cleaning processes and the appropriateness of the cleaning chemistry.

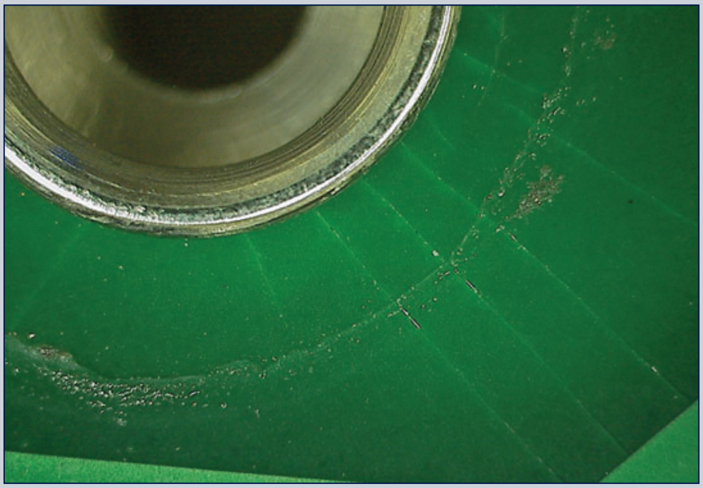

Figure 1: A white residue is often left after cleaning.

Rosin (RO) is the traditional flux type and is based upon tree sap (colophony). Resin (RE) based fluxes typically are synthetic and contain some form of organic polymer as the matrix. Inorganic (IN) fluxes are synthetic and can be composed of salts, alkali, or mineral acids. Organic (OA) fluxes are composed of weak organic acids other than rosin or resin. Water soluble fluxes are generally organic fluxes with high (H) activity levels.

Fluxes are identified by the activity level of the flux and its residue. The activity level describes the flux's ability to "clean" (remove oxides and tarnish) from solderable surfaces. Historically, activity was achieved through the addition of halides. Halide residues are very corrosive and their concentration levels are important. Less aggressive flux activity is achieved by the addition of a weak organic acid. Therefore, flux activity is identified by the absence or presence of halide (0 or 1) and also by the activity of the flux residue as represented by letters: L=low, M=moderate, H=high.

"No-clean" fluxes are also referred to as "low solid" or "low residue" fluxes. These fluxes are designed to leave a benign residue that may or may not be cleaned. No-clean fluxes typically have low (L) or moderate (M) activity levels. It is important to remember that "no clean" actually refers to the electronics manufacturing process where low solids fluxes are used. These electronic assemblies may or may not be cleaned.

Various laboratory techniques are available for quantitative and/or qualitative flux residue identification. ACI Technologies uses a dynamic ionograph for ROSE (Resistivity of Solvent Extract) tests. This test measures the overall ionic cleanliness of a sample by comparing the amount of flux residue left on a board to a salt (NaCl) standard. The ionograph works best with RO fluxes that easily dissolve into a bath of isopropyl alcohol (IPA) and water. Ion chromatography (IC) analysis is used to determine the types of ionic residues remaining on the assemblies. Specifically, IC measures individual levels of F, Cl, Br, NO_2, NO_3, PO_4, and SO_4.

ACI can perform Fourier Transform Infra-Red (FTIR) spectroscopy on liquid and solid samples. This is an excellent technique for identifying unknown residues. In addition, Scanning Electron Microscopy with EDS can be used to identify the presence of Bromides and Chlorides.

continued on next page

Surface Insulation Resistance (SIR) determines the corrosive effects of fluxes, conformal coatings, and cleaning materials. SIR testing also characterizes the material's resistance to creating short circuits. SIR testing is often used when changing cleaning materials and or changing flux chemistry.

In conclusion, ionic contamination left by flux residues can lead to corrosion and dendrite growth – two common causes of electronic shorts and opens. Other residues can lead to unwanted impedance, poor adhesion of solder mask and conformal coating, and physical interference with moving parts. Flux residues need proper identification in order to choose effective cleaning chemistries. ACI offers various analytical techniques (ROSE, IC, FTIR, SIR, etc.) to determine the root cause of contaminant problems and to evaluate the effects of process or materials changes on cleanliness.

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