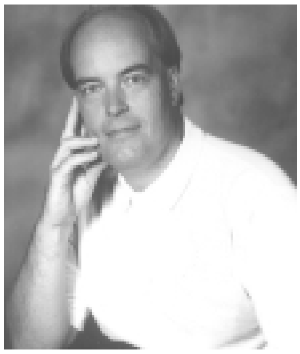
Component Compatibility for Cleaning



Bob Willis Process Guides

The cleaning process after soldering is chosen on the basis of the degree of cleanliness required, the type of flux residues to be removed and the accessibility of this residue to the cleaning solvent. Today the majority of assembly companies use a no-clean process but the solvent in the flux and due to condensate of the materials on to the surface of parts or absorption parts can still be effecting parts even if only cosmetically. The most common cause of this is overspray of flux during spray fluxing a process that generally goes hand in hand with no-clean processing.

With the demise of CFCs the options available are water cleaning, semi aqueous or solvent cleaning. All components must be chosen to be compatible with the cleaning process if used, rather than the process being modified to suit the components. Therefore it is important that during design of products and the procurement of components, compatibility with the cleaning materials used must be confirmed.

A component test program should be implemented to confirm compatibility, it is often not sufficient to just review literature from component manufacturers. Not only can some components be damaged by some cleaning processes, the interaction between the solvent and the component material can lead to increased contamination level on the final product. Certain components, such as open relay, can suffer ingress of water or contaminated solvent which is then retained within the component by surface tension forces until it evaporates, leaving the component with unwanted contamination or giving rise to potential corrosion problems. The use of some two stage or semi aqueous processes have suffered from this, the first cleaning agents can be trapped in parts and corrode the parts because the second stage generally water could not remove the cleaning agents.

Some components are simply uncleanable and must therefore be attached after the cleaning operations. It is common for component manufacturers to evaluate their parts with the common cleaning materials used in the industry. Unfortunately the testing which is conducted varies from manufacturer to manufacturer, the test methods may not accurately reflect the full production process.

Cleaning equipment manufacturers and solvent suppliers often evaluate different materials and sealants used in the manufacture of components. The tests are often based on the visual changes in the colour of the material or the size change in bulk materials. Assessment is made on the size of a sample block of material before and after immersion in solvent. Unfortunately this test method does not take into consideration the effect of stress placed on the components during moulding. Often cleaning can cause the stress in components to be relaxed and may lead to cracks becoming visible in the components.

Component Specifications

Specification for component compatibility testing do exist which may be used as a basis for company approval. Military Standard MIL STD 202 covers some basic test methods, but this is limited to the assessment of component markings using a brushing technique after contact with the test solvent. British Standard BS 9003 outlines test procedures for components along with the type of detail which should be included in a customer specification. This specification covers testing of the markings and the direct effects on the component body or sealing materials; it also highlights any problems with varnish coatings and potting compounds.

Proposals have been made in the past (Brian Ellis "Cleaning and Contamination of Electronic Components and Assemblies") to introduce a classification of components according to their resistance to cleaning products. With the increase in the number of cleaning options available this would now seem to be unworkable, but the basic concept is sound. The proposed specification suggested that components would be tested and then marked with a code to confirm which cleaning agents it was comparable with. Consideration was to be given to electrical and mechanical characteristics, markings, coatings, lubricants and electrical contacts. The aim of the specification was to enable component specifiers to take into account the resistance of parts to standard cleaning products, thus eliminating the need for evaluation by each user.

Plastic sleeving used to prevent the shorting of jump wires to underlying conductors should be compatible with subsequent cleaning procedures. Shrinkable sleeves should not be used where cleaning is required. In general, polyolefin materials are better than PVC. Braided wire allows high activity flux and cleaning materials to become trapped and should be avoided. It often leads to corrosion in side the sleeving and failure.

Examples of common cleaning are marking removal where the identification is either dissolved or softened and removed by subsequent handling. Stress cracking where the plastic absorbs solvent which causes expansion of the parts and flaking of the plastic. Further problems are seen when unsealed parts allow solvent to penetrate the components and remove lubricants or oxide retardants on switch contacts. This can shorten the operating life of the component or increase the contact resistance of the electrical contacts. One particular problem which can have a serious effect on electrolytic capacitors is the ingress of certain solvents which, when mixed with electrolyte in the capacitor, results in internal corrosion and ultimate failure of the parts.

Even semi-sealed parts may suffer from this problem if the parts are immersion cleaned directly after soldering. This is due to the change in temperature causing solvent to be sucked in to the device; during heating the parts expand during cooling they contract. If cavities exist as the board assembly moves from the soldering line and into the cleaning process forced cooling can result in solvent being drawn into the device even partly sealing with rubber seals aid companies' evaluation programmes a basic procedure is outlined which may be used to assess both conventional and surface mount component packages.

Test Methods

The test methods have been used by the author and does provide a very realistic view of component compatibility. The evaluation should be conducted alongside the normal Company Evaluation, with tests conducted on the electrical and mechanical properties of the component. A minimum of five to ten samples should be obtained for each component type under evaluation.

The test should consist of complete immersion in the specified test fluid. After test, the components should be removed for examination. The following points may be considered:

Material attack.
Discoloration.
Stress cracking.
Weight Change
Surface Swelling
Loss of identification.
Evidence of failure of sealing and adhesives.
Changes in mechanical/electrical properties.

Cleaning Test Procedure

The test and its sequence will depend on the type of component being evaluated. The following is suggested as a basic guide to the sequence of operations

Examine each sample for any defects which may cause the final results to be suspect.

Number each component in a way which will not affect the final results.

Measure the weight of each sample, using equipment which relates to the size of the sample under test. Measure relevant dimensions of the component body

Using a still system provided for component evaluation, boil a quantity of test fluid sufficient to cover the samples. Each sample will be held in the boiling fluid for three minutes minimum, at which time it will be removed for examination. The cleaning fluid should be used for evaluation purposes only. The temperatures of the test fluid will be what is recommend by the material supplier. The temperature of the test fluid should be checked with a thermocouple.

In the case of semi aqueous solutions there will be a requirement for two test immersions and a drying stage. The drying stage test will depend on the methods use during assembly a static batch process or a inline cleaning system as the surface temperatures on the components will be different with each process.

Directly on removal from the solvent, each component identification will be examined for loss of markings.

Each sample will then be re-weighed to establish any solvent absorption due to unsealed devices or absorption of the material under test. Measurement of component dimensions should be re measured for any changes.

Examination should be conducted under 10 x magnification for any defects caused by the test programme

Depending on the component type, further destructive testing can then be undertaken. The further testing will depend on whether the samples are to be electrically or mechanically tested as part of a company test programme. Many detergents can get in side components and start to corrode plating, attack wires, harden plastics etc.

This modified text was written for and featured in the cleaning text book written by Dr Colin Lea titled "After CFCs Options for Cleaning Electronic Assemblies" it was also featured in internal specifications and on CD ROM Surface Mount Process Defect Guide and Inspection and Quality Control in Conventional and SMT Assembly.

Bob Willis is a process engineer providing engineering support in conventional and surface mount assembly processes. He runs production lines for suppliers at exhibitions and also provides seminar and workshops world wide. Bob has one of the largest collection of training videos, interactive CD-ROMs and training material in the industry. Bob will be presenting four Master Classes at APEX in California, he will also be presenting classes at SMT Nuremberg in Germany for those engineers visiting the show. For further information on how Bob may be able to support your staff contact him via his web site **www.bobwillis.co.uk**

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