MEMORANDUM

AAT Spray In Air Stencil Cleaner vs Ultrasonic Stencil Cleaner (tested with Indium SMQ 92 NC and various cleaning agents)

Both ultrasonic and spray-in-air cleaning methods have been extensively used for electronics cleaning applications, particularly stencils and mis-printed circuit boards. Austin American Technology provides a large variety of different cleaning machines for many diverse cleaning applications including: low pressure spray in air, high pressure spray in air, spray under immersion, ultrasonics, solvent cleaning, aqueous cleaning, batch cleaning, in-line cleaning, etc. As a result, Austin American Technology has extensive experience and expertise in each of the listed cleaning methodologies and techniques. In the past, Austin American Technology conducted extensive research in the area of ultrasonic cleaning. In fact, a prototype stencil cleaning machine was developed in order to satisfy a market segment that demands ultrasonic cleaning. After extensive testing and evaluation of the ultrasonic cleaning and spray-in-air methods it was very clear that the performance, effectiveness, and consistency of the spray-in-air technique could not be matched. The following parameters were studied and tested in great detail:

I. Performance
II. Maintenance
III. Environmental impact

The choice of the cleaning fluids temperatures, and concentrations affect these parameters significantly. In order to maintain fairness and consistency in the final conclusions, the same cleaning fluids were tested in both spray-in-air and ultrasonic equipment. The tests were limited to aqueous cleaning agents. These can be classified as alkaline detergents (AD), neutral detergents (ND), and alkaline saponifiers (AS) (Ethanolamine based). This is a summary of the test results:

Solder paste: Indium SMQ 92 NC
Operating temperature: 122º
Concentration: 10% (by vol.)

I. Performance

For stencils, the performance of the AS and ND cleaning agents is comparable for ultrasonics and spray-in-air in the first cycle (while the chemistry is completely clean. The performance of the AD cleaning agent is substantially inferior. It can be said that the cleaning results for misprinted boards are the same as well. After a series of cycles (>15), as the chemical agent becomes progressively loaded with flux residues, the performance of the ultrasonics method decreases substantially when compared with the spray-in-air method. The actual cause for the decrease in performance remains unknown. It is argued that the flux concentration in the liquid medium influences the cavitation efficiency of the liquid. Also, the fact that solder paste accumulates in the bottom of the process chamber indicates a possible cause for a decrease in efficiency specially if some ultrasonic transducers are located at the bottom of the chamber

II. Maintenance

In addition to performance, the issue of maintenance as it relates to the removal of solder paste from the stencil cleaner is considered critical. Removal of solder paste from spray-in-air machines is dependent on the actual design of the equipment. In any case, in most cases the solder paste is collected in the wash reservoir and is filtered continuously while the machine is in operation. The scheduled maintenance frequency depends on the machine usage but it simply consists in emptying 6 gallons of fluid temporarily into a container and removing any solder paste with a wet vacuum cleaner (or by hand). The key is that the wash reservoir is easily accessible. The estimated time to complete this operation is 10 to 15 minutes. For ultrasonic cleaning machines, the solder paste removal is complicated by the fact that the solder paste is collected inside the process chamber. Generally it requires the evacuation of the cleaning fluid (which is usually about 40 gal.) The major difficulty is presented by the inaccessibility to the bottom of the process chamber. The estimated time to complete this operation is 2 to 4 hours. In addition to the

cleaning equipment maintenance, when evaporators are used, they present additional maintenance issues. In the case of ultrasonic systems, the fluids transferred into an evaporator are usually concentrated solutions in large quantities (about 40 to 50 gal.) After the aqueous fluids are evaporated, the remaining sludge (solids) must be removed and disposed as hazardous waste, creating in the process additional maintenance and environmental concerns. Conversely, when evaporators are used in conjunction with spray-in-air systems, the transfer volumes and level of contaminants into the evaporator are more manageable, about 2 gal. per cycle of pre-filtered rinse water.

III. Environmental

Finally, environmental concerns must be considered as well. These are highly dependent on the chemistry selection. Alkaline chemicals must be treated as hazardous. In addition, it is well known that alkaline fluids promote the solubility of lead, and as a result they add an additional hazardous component (in addition to pH). These facts are true for both spray-in-air and ultrasonic systems. However, the latter require handling amounts of 40 gal. In both the equipment and the evaporator compared to 6 gal. in the spray-in-air systems.

As a result of the performance, maintenance, and environmental disadvantages, AAT decided to discontinue plans to market an ultrasonic stencil cleaner last year. Additional potential concerns related to the compatibility of substrates (stencils and circuit boards) with ultrasonic energy that should be checked out prior to use are:

Ceramic capacitor damage
Screen de-lamination
Solder ball re-deposition (because of no filtration)
Wire bond damage
Glass seals damage (diodes)

In contrast with ultrasonic cleaning methods, spray-in-air systems present the following advantages:

1. Process flexibility in terms of cleaning fluids

Spray-in-air systems are optimized by selecting different cleaning fluids depending on the constrains and nature of the cleaning application. For example, in some instances aqueous fluids may be ideal while in other cases solvent fluids may be more effective. The AAT X-30 stencil cleaner is used throughout the industry with aqueous, solvent, and macroemulsion liquids.

2. No potential for component damage

In absence of ultrasonic energies there is no possibility for component deterioration (chemical compatibility with fluids must be studied in advance).

3. Process stability

Unlike in ultrasonic systems, the chemical concentration of the wash fluid can be maintained constant regardless of the number of cycles if the metering pump option is implemented.

4. Wide range of cleaning applications in a single system

Spray-in-air systems have been successfully installed for multiple applications such as adhesive removal, NC paste removal, OS paste removal, and reflowed flux removal in a single cleaning machine. In general, ultrasonic systems are limited to solder paste removal only.

It is for these reasons that spray-in-air systems are the preferred cleaning method of most large OEMs and contract manufacturers.

Thank you for your inquiry and feel free to contact me or Steve Stach if you have any further questions.

Sincerely,

Steve Stach
Applications Engineer