



## TECHNICALLY SPEAKING

AUGUST 2004

VOLUME 3

NUMBER 1

### Cleaning: It's All In Finding The Right Balance

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A number of factors must be considered when removing contaminants from the surfaces of printed circuit boards and electronic equipment. Finding the proper balance between these factors will greatly improve the speed and efficiency of the cleaning process. Selecting the proper cleaner for the soil type to be removed and compatibility with the surface to be cleaned, selecting the proper cleaning method, finding the right mix of cleaner concentration, temperature, residence time, and cleaning action, are all criteria that must be taken into account when designing the most efficient and cost effective cleaning process. Further complicating the picture is the need to consider solvent toxicity, in relation to worker exposure and safety, and the requirements of local environmental regulations, concerning air emissions and disposal of waste products.

First, consider what type of soil needs to be removed from the surface of the equipment or circuit board. This will immediately suggest the best cleaner to be used for the job. If the surface is covered with light dust and particulates, then an Ultrajet<sup>®</sup> duster will suffice to remove these loosely bound contaminants.

If the contamination to be removed is ionic in nature (flux residues, inorganic salts, acidic materials) then you will need to perform the cleaning using a product containing **polar** solvents, like water or alcohol. If **non-polar** substances like oil and grease are present on the surface, further trapping dust and particulate matter, then it will be necessary to choose a **non-polar** solvent cleaner to dissolve the oil and grease and flush away the bound particulates. Non-polar solvents like isohexane and other hydrocarbon-based cleaners are good solvents for dissolving non-polar oils and grease. Many Chemtronics solvent cleaners contain both polar and non-polar solvents, so they will be effective on all types of contaminants. Electro-Wash<sup>®</sup> PX, the Mighty Liquid<sup>™</sup> and the new fluorinated solvent mixtures, like Cirozane<sup>®</sup> and Verizane<sup>®</sup>, are outstanding cleaners for both ionic and nonionic soils.

Along with matching the cleaner to the type of contamination to be removed, you also need to consider if the cleaner is compatible with



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the surface material being cleaned. You would not want to use a strong, aggressive cleaner on a painted surface, for fear of removing the paint. Likewise, plastic surfaces can be effected by some of these same solvents. Cleaners containing strong ketones, like acetone, or chlorinated solvents, like methylene chloride, will lift the paint from metal surfaces or melt soft plastics like polycarbonate and polystyrene. The surface of harder plastics can be discolored or “crazed”, developing fine cracks and abrasions, when exposed to ketones and chlorinated solvents. The “Xtra Strength” Chemtronics cleaners, like Electro-Wash<sup>®</sup> NX, NXO and Flux-Off<sup>®</sup> Heavy Duty should be tested for compatibility with any plastics present in the cleaning application, before widespread use.

Next, consider what is the fastest and cheapest way to do the cleaning? If the decision is made to use a solvent cleaner, then we need to consider whether to use an aerosol product or a bulk liquid. If only a few boards are to be cleaned and the cleaning takes place infrequently, then it is probably less costly and more convenient to use an aerosol product. If many boards are to be cleaned, then using a bulk liquid cleaner may be more cost effective.

In some situations, the concentration of the cleaner being used is also a consideration. Solvent-based cleaners like the Electro-Wash Cleaner/Degreasers and most of the Flux-Off<sup>®</sup> Flux Removers are not dilutable, and can only be used full strength. **Water-based** cleaners, like Flux-Off<sup>®</sup> Aqueous, are usually sold as concentrates and can therefore be diluted with water to the concentration that is found to give the best cleaning. For Flux-Off<sup>®</sup> Aqueous we recommend that the user first dilute one part of the cleaner with 10 parts water, as a starting point for determining the best cleaner concentration. Being able to dilute the cleaner also has the advantage of lowering the cost of the cleaning process.

If you are trying to remove a thick coating of rosin flux, oil and grease, or stripping a conformal coating from the whole board, then its best to increase the **residence time**, that is, the time the soil is exposed to the cleaning solvent, by immersing the board in the cleaning solvent.



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Immersion cleaning can be done at **room temperature** (sometimes referred to as cold immersion cleaning) or, in some cases, a heated bath. **Heating** the cleaning solution will greatly increase the speed at which it works. Of course, only those solvent cleaners with **flash points** above 200 °F (consult the product MSDS) should be heated, to avoid the possibility of igniting flammable vapors. **Agitation** or stirring the cleaning solution during immersion adds mechanical action, which can also speed up cleaning. Similarly, such cleaning can be performed in an ultrasonic bath, if available. Transmitting sound waves through the cleaning solution produces fine bubbles (cavitation) which “scrub” the surface of the board. Some ultrasonic baths also allow you to heat the cleaning solution, further increasing cleaning efficiency.

Encrusted soils lying under components are especially hard to remove. If the residence time in the cleaning solvent is too short, the solvent does not have sufficient time to penetrate under the components. There will be only a partial dissolving of the trapped residue, some of which will flow across the board. As the solvent cleaner evaporates, this partially dissolved residue will precipitate onto the board, leaving streaks of soil across the board surface. This is an indication of “incomplete” cleaning, and is easily solved by running the board back through the cleaning process, as many times as required to completely flush all soils from underneath the components. In an automated cleaning process, the speed at which the boards pass through the cleaning process can be decreased to allow the boards a longer time of exposure to the cleaning solution.

To sum up all the above information, proper cleaning of an equipment surface or electronic assembly requires finding the right balance between the variable conditions of **cleaner-contaminant/substrate compatibility**, **cleaning method**, **cleaner concentration**, **residence time**, **cleaning temperature**, and **agitation**. All cleaners will not work equally well with the same types of soils, in the same types of cleaning equipment and processes, or in the same amount of time. Each cleaner has its strengths and weaknesses and finding the right balance of the above factors, for the particular cleaner being used, will result in developing the fastest and most cost effective cleaning method for a particular application.