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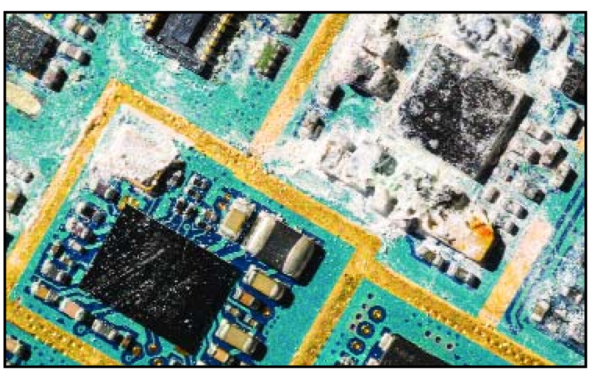
# Improving PCBA Reliability Through Modern Cleaning Methods

**By Emily Peck, Senior Chemist, MicroCare Corporation**

The drive towards miniaturization in the electronics industry is relentless. As more advanced electronic applications are designed, which require increased functionality in ever-smaller packages, manufacturers are looking for production methods that result in devices with greater reliability.

The smaller, more densely populated circuit boards required for this new generation of technology are making the issue of managing faults, quality and product longevity highly challenging. The use of miniaturized PCBs is making circuit board cleaning more difficult. Cleaning is essential to ensure a trouble-free performance. If not cleaned effectively, contaminated PCBs can fail in the field, resulting in malfunctioning devices, extensive product recalls and costly warranty replacements.

The risk of failure can be devastating. Think critical applications like heart pacemakers or airbag sensors. If these do not work efficiently the consequences are catastrophic. They need to operate reliably every time without exception. These PCBs are also typically used in products that must endure challenging conditions over a long period of time. They need to work perfectly under any circumstances and withstand harsh conditions that include persistent exposure to humidity, extreme temperatures and climates and continuous vibration.



***White residue is a common PCB contaminant.***

PCBs are often used in applications where replacing the assembly can be difficult or nearly impossible, such as electronics used in down-hole logging, space station communication systems or implantable medical devices. These all require huge amounts of time, effort or expense to access, so it is critical that these PCBs function without fault.

Some PCB failures occur intermittently. It can come off the manufacturing line in good working order only to lose some functionality or performance over a period of time. In some cases, the electronic product affected may be "throw-away." A mobile phone, for example, is upgraded frequently, keeping it from being such a problem. However, for long-lived devices, like a fetal monitor, an electric train motor or an elevator controller, the consequences of a failure are much more of a concern.

### PCB Cleaning Increases Reliability

One of the main reasons for PCB failure is contamination. The smallest contaminant can form a barrier between contacts and parts. Dirty PCBs are susceptible to a whole host of problems, from electrochemical migration and delamination to parasitic leakage, dendrite growth and shorting.

Modern PCBs are small, multilayered, complex systems with bottom termination components such as BGAs, CSPs, MLFs, QFNs, and D-Paks. These new designs make effective cleaning a challenge. Being able to remove contaminant under and around tightly-spaced components is difficult.

Add to this the low standoff between conductors, which can collect and trap contaminants like solder balls, and the challenge increases. In many instances, active fluxes or flux residue may stay on the PCB after reflow or after hand soldering. There can be other contaminants, such as ink and fingerprints, that require removal.

One of the most common types of contamination directly impacting PCB performance is ionic residue, typically flux left behind during the manufacturing of a PCB, or after the soldering process. Another contamination culprit is no-clean fluxes.

Today, the need to clean no-clean flux residue is essential for long-term PCB performance and functionality. Designed to stay on the board, no-clean flux can leave behind a white residue when the salt activators in the fluxes come in contact with heat or other chemicals. This residue can corrode fragile circuits and enable dendrite growth.

This can potentially create noise on the board or interfere with signal transmission, particularly in high-voltage systems. Frustratingly, "no-clean" flux is some of the most stubborn and difficult contamination to clean from PCBs, without the correct cleaning methods.

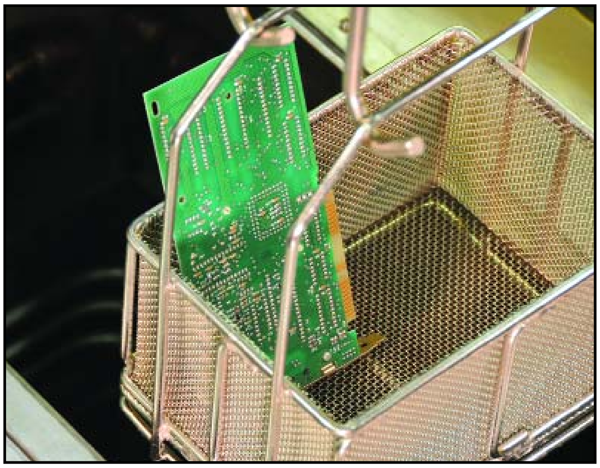
## How to Clean PCBAs Effectively

It is crucial to ensure that cleaning procedures are in place to guarantee clean boards. There are several methods to reliably clean PCBs, whether it be a vapor degreaser or manual cleaning.

Vapor degreasing is one of the most efficient and effective cleaning processes available. It offers excellent performance when cleaning miniature components and uses an environmentally sustainable cleaning fluid, instead of water. PCBs come out clean, dry, spot-free and cool enough for immediate coating or packaging. Vapor degreasers recycle and reuse cleaning fluid for hundreds of hours before the fluid must be refreshed.

Aqueous PCB cleaning typically uses deionized water and detergent in a series of washing and rinsing cycles, which takes place in large machines. A second operation, using heat or air, dries the PCBs. Aqueous systems are considered to be environmentally, but they consume relatively large amounts of electricity and require continuous water monitoring and stringent wastewater management.

Benchtop cleaning is necessary in some circumstances. If the PCB is missing elements, such as surface mount components, these will be soldered by hand onto the PCB at a later stage. There may also be fragile or moisture-sensitive components that can only be hand soldered in place after the initial PCB cleaning. These selectively-soldered PCBs usually undergo a spot cleaning at the bench, using a fast-drying aerosol-packaged flux remover and a brush.



***PCBs cleaned in a vapor degreaser come out clean, dry and cool.***

## Spot Cleaning

If flux residue and other contaminants must be removed manually from PCBs, it is important to ensure that the operator is trained in all four steps of wet, scrub, rinse, and dry. First, wet the board with a pure cleaning fluid. Then, scrub it using a quality scrubbing brush. Next, rinse with more clean fluid. Finally, dry the board with a lint-free wipe, a high-quality air duster, or a combination of both.

This recognized manual process is effective at cleaning select PCBs, because it allows the operator to adjust the amount of cleaning fluid delivered, how much scrubbing and rinsing takes place and how well the boards are dried.

## Controlled Cleaning

The ideal protocol after secondary soldering takes place is to clean the entire PCB. It is important to do this in a controlled manner to regulate the flow and volume of the cleaning fluid being used. The use of a dispensing system that attaches to the aerosol can is key to control. This method delivers faster and better cleaning, with less waste and more precision.

Sealed fluid dispensing systems are now replacing pump bottles and brushes. Using a controlled dispensing system keeps the flux remover clean for each use. The cleaning power of the flux remover is amplified by the mechanical scrubbing action of the brushes. A secondary spray of the flux remover thoroughly rinses and washes away contaminants.

A quality dispensing system will deliver the right amount of fluid to wet the PCBA completely, but without overspray or waste, using 50 to 60 percent less fluid. Through the use of a controlled dispensing system, workers are exposed to less flux remover. Benchtop cleaning with a fluid dispensing system is a simple and effective way to help protect workers and deliver consistently clean circuit boards.

Successful cleaning involves identifying the contaminant and then selecting the best combination of cleaning fluid and method to effectively remove it. Balancing these factors properly can enhance PCB reliability. To ensure reliability and implement the right cleaning procedures, it is recommended that PCB manufacturers work with a knowledgeable cleaning partner that specializes in specific cleaning fluids for this task. These experts can help choose the best cleaning process and fluids to deliver quality cleaning.

*Contact:* MicroCare Corp., 595 John Downey Drive, New Britain, CT 06051 ☎ 1-860-827-0626
E-mail: info@microcare.com
Web: www.microcare.com ❒

**See at IPC APEX, Booth 2643, and ATX/MD&M West, Booths 2343 and 616**