Tech Article

# Cleaning Printed Circuit Boards at the Benchtop: Three Options

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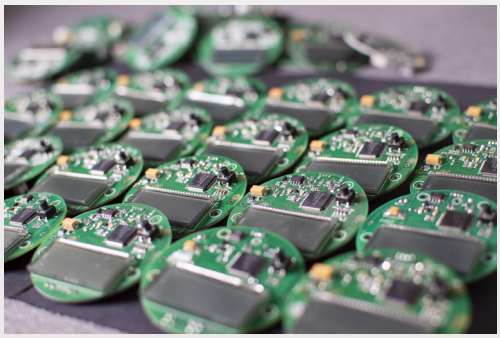

*Cleaning is important to the success of all PCBs.*


*The dip and brush cleaning method can lead to cross-contamination.*

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The increasing demand for consumer electronic devices, IoT technology and rise in electric vehicles are seeing a surge in more complex Printed Circuit Board (PCBs). In addition, the complexity of PCBs continues to grow as more sophisticated devices require smaller, denser multi-layered PCBs. This density increase inevitably means there is a higher reliability risk, a major concern for many manufacturers. Even high-quality PCB assemblies can fail occasionally. This results in the need for benchtop rework or repair, a process that is increasingly important due to the recent raw material shortages and availability issues caused by the COVID-19 pandemic. Fabricators are doing everything they can to reduce board scrap and use every single PCB produced. Benchtop or manual cleaning is an important process in PCB rework and repair. Without proper cleaning procedures in place, reliability issues can continue and lead to PCB malfunction.

Contamination is a common and significant cause of PCB field failure. Contaminants can come from a number of sources. This includes fingerprints, adhesives, flux residue and uncured solder paste. Dirty boards can cause a number of reliability issues including shorting, board delamination, electrochemical migration, parasitic leakage and dendrite growth.

Benchtop cleaning is important to the success of all PCBs. Whether they are used within consumer goods like smartwatches, home security systems or GPS mapping or in more critical applications like heart pacemakers, military weapons systems or autonomous vehicle controls, the PCBs inside must function without fault. Benchtop cleaning must be completed correctly and effectively to guarantee the lifespan of the electronic assembly and ensure consistency. If it isn't completed successfully any contaminant left on the board may negatively affect the performance of the PCB.

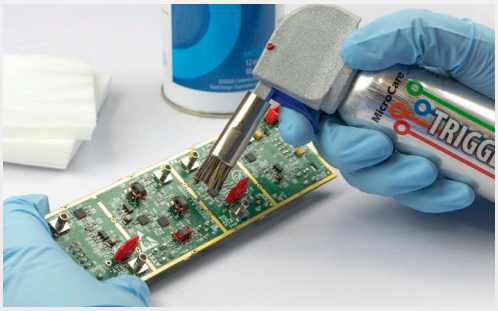
Benchtop or manual cleaning is an important step in the assembly of PCBs. This process is used during initial assembly, for touch-up during post-reflow assembly or rework and repair. The primary methods used at the benchtop for manual cleaning are dip and brush, aerosol spraying and the wet, scrub rinse and dry technique. Each has varying degrees of success.

**Dip and Brush Cleaning**

The dip and brush cleaning method has been used by PCB fabricators for decades and was once seen as the benchmark during rework and repair. Cleaning is done with the use of a low-cost cleaning fluid, usually Isopropyl Alcohol (IPA) dispensed from a pump bottle and an acid brush. The biggest disadvantages of the dip and brush method is cross-contamination of the fluid and lack of process control.

When spot cleaning to remove flux residue from a section of a recently soldered PCB, a technician dips a brush into the cleaning fluid in the reservoir top of a spring-loaded pump bottle (sometimes referred to as a Menda bottle). The brush is then wiped across to the soldered areas of the PCB. When using this method, the cleaning fluid dilutes the flux, but it can also spread the contamination to other areas of the board. Many times, the diluted flux relocates elsewhere on the PCB including under nearby SMT components. Some of the flux also makes its way onto the brush. As the IPA evaporates,

*Aerosol cleaning is messy and expensive due to the high volume of wasted cleaning fluid.*



*A dispensing system uses the four-step method of wet, scrub, rinse and dry for reliable, consistent and controlled PCB cleaning.*

it deposits the flux residue on both the PCB and the brush. This allows the contaminated brush to transfer deactivated flux back into the pump bottle, resulting in further contamination. If this dirty fluid and brush are then used on future PCBs, it only adds to the contamination problem.
The way to alleviate cross-contamination is to clean and rinse the entire board with fresh cleaning fluid every time. This includes replacing the fluid in the pump bottle and rinsing the acid brush after every use, a time consuming and costly practice!

Additionally, process control is difficult when using the dip and brush method. Dip and brush cleaning isn't easy to monitor. So, cleaning can be hit or miss, depending on the skill or experience of the technician. Some technicians use too much cleaning fluid, while others don't use enough. Some use too much pressure, and others too little. This results in inconsistent cleaning and dirty boards. With today's highly complex, miniaturized PCBs, the dip and brush cleaning method simply doesn't meet the exacting standards required for reliability.

**Aerosol Spray Cleaning**

Aerosol spray cleaning is another common PCB benchtop cleaning method. An improvement on the dip and brush method, this cleaning process provides a consistent flow of uncontaminated fluid when cleaning. Aerosol spray cleaning removes the cross-contamination problem. However, it still has issues with process control since the spray is difficult to control. It is messy and expensive due to the high volume of cleaning fluid needed to cover the entire board.
There are add-on straw attachments that can help control the flow and direction of the fluid. But any cleaning power relies solely on the pressure in the straw to blow out trapped contaminants from under low-mounted components. Worker exposure to cleaning fluid fumes when dispensing the fluid from the aerosol can is also a definite disadvantage.

**Wet, Scrub, Rinse and Dry Cleaning**

The four-step method of wet, scrub, rinse and dry is the most reliable, consistent and controlled cleaning method for benchtop PCB cleaning. This process requires using an advanced PCB cleaning fluid in an aerosol can, a controlled dispensing system with an integrated brush like the MicroCare™ TriggerGrip™ PCB Cleaning Tool, and a lint-free wipe.

*Step 1* is to wet the board with the pure cleaning fluid. MicroCare offers a variety of PCB cleaning fluids and flux removers. Each is engineered to clean specific contaminates from lead-free fluxes to fingerprint oils to no-clean solder pastes and fluxes. With the TriggerGrip™, the fluid is directed to the exact area on the PCB requiring cleaning to loosen the contaminant.

The TriggerGrip™ tool reduces cleaning fluid waste. In fact, technicians typically use up to 60% less cleaning fluid with this controlled dispensing system. The dispenser hose attaches to the can of cleaning fluid giving the technician better control of where the cleaning fluid goes and how much is dispensed. This reduces cleaning fluid waste, resulting in cost-savings.

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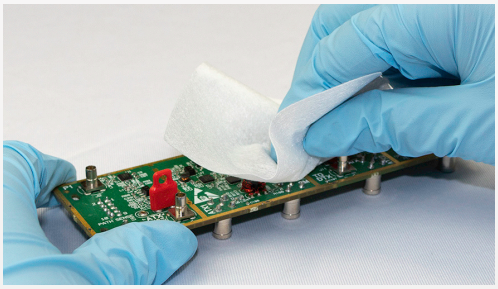

*Drying is an important step to ensure PCB reliability.*

The improvement to worker safety is a distinct advantage of the TriggerGrip™ tool. Since less fumes are expelled, it is better for both those cleaning the board and for the environment. The TriggerGrip™ tool is also a closed-loop system. This prevents the risk of fire since technicians don't have to transfer highly flammable cleaning fluids into smaller bottles from larger pails or drums. The TriggerGrip™ tool also uses every last drop of cleaning fluid within the can. This means fewer discarded aerosol cans going into the landfill, helping companies become more sustainable.

*Step 2* is to scrub the circuit board with a brush to take off hard-to-remove particulates or oils. The TriggerGrip™ tool has interchangeable scrubbing tools which are fed by the aerosol can. This includes different size brushes and syringes to ensure cleaning fluid gets under low surface mounted components for more thorough cleaning. Because the applicator boosts the cleaning power of fresh, pure cleaning fluid with the mechanical scrubbing motion of the brush, it delivers outstanding results.

*Step 3* is to rinse the board with fresh cleaning fluid directly from the TriggerGrip™ tool to ensure all contaminant is removed. It is important to remember that if you can't rinse you can't clean. It is essential to ensure that all contaminant like uncured solder paste and flux residue washes off the board. Finally, step four is to wipe the board dry with a soft, clean, absorbent, and lint-free wipe. This ensures every last contaminated particle is removed and the board is dry to prevent problems like dendrite growth.

The four-step benchtop cleaning method using the TriggerGrip™ tool wins hands down when it comes to reliability, consistency and process control. It also has the added benefits of being safer for workers, as well as economical in both money and time.

**Setting the Bar for Benchtop Cleaning**

PCB fabricators performing benchtop rework and repair on PCBs must carefully consider what cleaning process to adopt to ensure PCB longevity and reliability. When it comes to benchtop manual cleaning, the four-step process of wet, scrub, rinse and wipe addresses these concerns. This method includes essential cleaning capabilities for smaller, more tightly packed PCBs, but also tackles worker safety, and environmental concerns.

**About the Author:**
*Emily Peck is a Senior Chemist at MicroCare which offers benchtop and vapor degreasing critical cleaning solutions. She has been in the industry more than 6 years and holds a MS in Chemistry from Tufts University. Peck researches, develops and tests cleaning-related products that are used on a daily basis in electronics, medical, fiber optic and precision cleaning applications.*
*For more information, visit www.microcare.com.*

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