Tech Article

Cleaning and Drying Before Conformal Coating: Why it's Important

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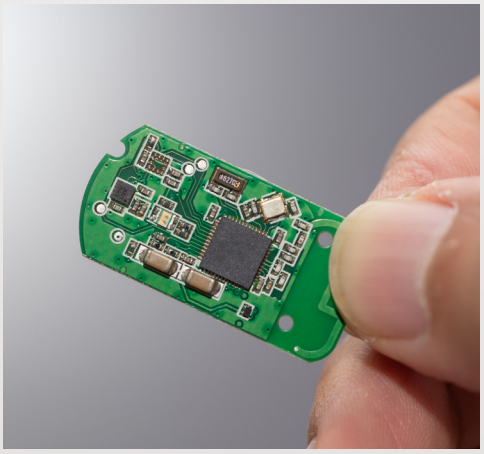

Finger print oils and salts must be removed prior to conformal coating.

PCBs (printed circuit boards) are subjected to many harsh environmental conditions. This includes extreme temperatures, strong chemicals, corrosive salts, dust and moisture. Therefore, encapsulating them with a protective conformal coating makes sense. Conformal coatings keep harmful elements from touching the delicate components and degrading the performance of the boards. However, for optimum PCB longevity, functionality and reliability it is imperative that the boards are perfectly clean and dry before conformal coating.

PCB contamination comes from many sources including transport, handling, storage and manufacturing. The most common examples of PCB contamination are varied. They include fingerprint oils, salts and flux residue, as well as tape or other adhesive residue, solder balls, and even some inks or chip bonder.

Any contaminants or soils on PCBs may interfere with the proper bonding of the conformal coating to the PCB substrates. For example, if salts or oils from fingerprints are left on the boards, they cause defects in the conformal coating. These include uneven coverage, pinholes, craters, blisters and fish eyes.

In addition, flux residue absorbs and holds moisture. If the residue is sealed under the conformal coating, it will likely cause cracking and peeling when the conformal coating is cured and the trapped moisture releases. If that compromised board then makes it into the field, problems can occur. Dust, water and salts can penetrate it resulting in a variety of damage including delamination, parasitic leakage, dendrite growth, electrochemical migration and shorting. In extreme conditions it may also result in complete component failure. Therefore, to prevent performance problems, cleaning the contaminants and drying the PCBs prior to conformal coating is absolutely essential.

Clean and Dry Before Coating

Cost typically prevents many manufacturers from cleaning and drying before conformal coating. Those steps may seem like an unnecessary expense due to the extra time and cleaning fluid costs involved. However, cleaning and drying prior to coating improves PCB life-expectancy and reliability. It also helps prevent unpredictable board performance, costly PCB failures, disruptive product recalls and expensive product returns. Not to mention the added time and expense of removing a conformal coating to rework a malfunctioning PCB if it fails due to environmental exposure. So, cleaning and drying is typically worth the extra investment in time and materials.

There are two popular methods of cleaning and drying PCBs. Manual cleaning at the benchtop or automated cleaning using a vapor degreaser.

Benchtop Cleaning and Drying

There are four steps to successfully cleaning PCBs at the benchtop. Wet, scrub, rinse and dry. Using these four steps ensures a good coating that adheres to the PCB, cures without damage and resists delaminating when exposed to extreme conditions. First, wet the board with a pure cleaning fluid. Second, scrub it using a good quality scrubbing brush. Third, rinse away any by-products with more clean fluid. The final and fourth step is to dry the PCB completely to prevent moisture from being trapped under the conformal coating.

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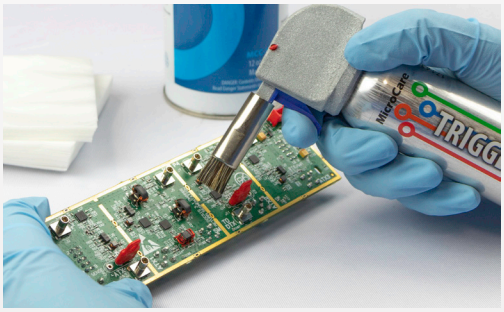
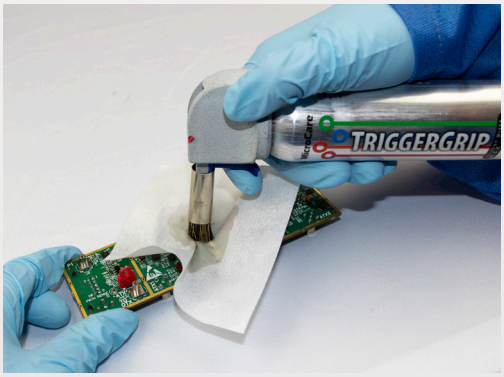
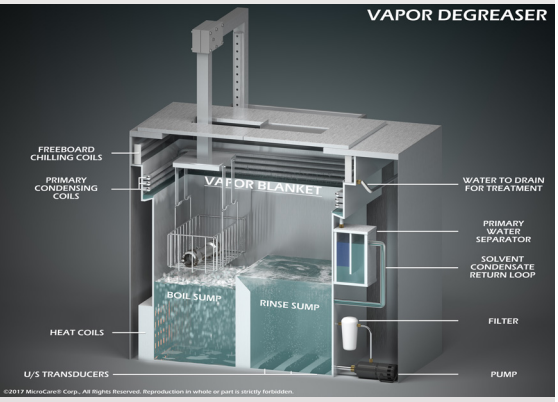


The four steps to successfully cleaning PCBs are wet, scrub, rinse and dry.



Clean and dry at the same time by scrubbing through a wipe.



Vapor degreasing cleans and dries PCBs in one step.

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Manual drying is accomplished in a few different ways during benchtop cleaning. One of the most common methods to dry PCBs is with a simple lint-free wipe. Gently push the wipe under low-mounted SMT components to absorb any excess spray of cleaning fluid. Or clean and dry at the same time by scrubbing components through a wipe placed on top of the board.

Another way to dry PCBs before coating is with a dust remover. This can be a quick and effective way to blow out trapped moisture from underneath larger components that a wipe alone may not reach. When the dust remover is targeted to a very precise area on the PCB, it works well to eliminate moisture in hard-to-reach areas of the circuit board. In addition, combining a duster with a wipe will double the drying power and prevent the fluid from being pushed back onto the board therefore spreading contaminant around.

Vapor Degreaser Cleaning and Drying

As PCBs continue to shrink in size due to the demand for smaller and smaller electronics, manufacturers are squeezing multiple micro components like flip chips, micro BGAs and CSPs into tighter spaces on the boards. Low standoff components like MOSFETs and bottom-termination packages like QFN (quad-flat no-leads) are now commonplace. As a result, these tiny, stacked, high density and complex PCBs are more susceptible to functionality problems, especially if exposed to harsh conditions. So, good cleaning and conformal coating is an absolute necessity.

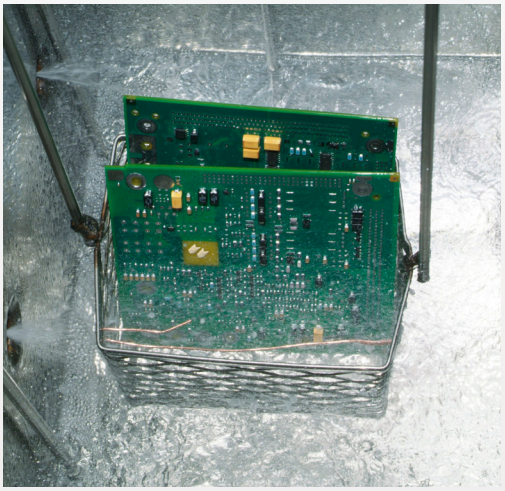
But the dense construction of these PCBs makes them hard to clean and even more challenging to dry. Cleaning fluid often traps under these components leaving the PCBs dirty, at risk of cross-contamination and unprepared for conformal coating.

A good solution for effectively cleaning small, complex PCBs is to use a vapor degreaser and a modern, sustainable cleaning fluid. Vapor degreasing uses cleaning fluid immersion, combined with vapor rinsing and vapor drying. It removes all types of contaminates including fluxes, pastes, particulates and residue. The fluid easily gets into and under all components. But, but more importantly, it gets out of the tiny channels between stacked components.

How Vapor Degreasing Works

Vapor degreasing machines range in size from small benchtop models to huge floor systems. No matter what the size vapor degreaser, the cleaning and drying processes are the same. The vapor degreaser boils a cleaning fluid at a low temperature, usually between 40°C/105°F and 65°C/165°F, to produce a pure, clear and dense vapor blanket. PCBs are lowered into the boiling cleaning fluid in the boil sump to heat, loosen and remove the majority of the contamination. They then move to the rinse sump where any final vestige of contamination rinses away. Finally, the PCBs are raised up and held inside the vapor blanket, allowing the parts to dry and cool. The entire process takes approximately 6-20 minutes per batch.

The cleaning fluid has a low surface tension allowing it to permeate the entire board, including under and in-between tightly-spaced components to wash away fingerprint oils, fluxes and residue. Using a low temperature fluid minimizes the risk of damage to the PCB components and since the cleaning fluid is ultra-pure, it leaves no residue behind.



Vapor degreasing uses cleaning fluid immersion, combined with vapor rinsing and drying to remove contamination.

The vapor blanket dries the PCBs quickly. The vapor passes under the low-mounted components, so that the PCBs come out of the vapor degreaser completely dry, and cool enough to handle. This is important since the PCBs need to be cool to help the conformal coating adhere to the board.

Removing Conformal Coatings

If absolutely necessary, conformal coatings are removed for rework and repair the PCBs. However, removing conformal coatings is challenging since they are designed to be very durable and by nature, hard to remove. If rework is required, the best way to dissolve the conformal coating is to use a cleaning fluid with a chemical composition similar to the contamination.

For example, for silicone coatings, choose a siloxane-based remover, so it is chemically very similar to the silicone conformal coating. Other conformal coatings like acrylic, epoxy and urethane are more difficult to remove. They often need stronger, more aggressive cleaners and may require soaking to soften the coating before removal. Other conformal coatings, especially those used in military applications are rock-hard and simply cannot be removed chemically. They often require physical abrasion like sandblasting which can damage the PCBs.

To Sum Up

To ensure reliability and functionality it is crucial to ensure PCBs are both clean and dry prior to conformal coating. By properly preparing the PCBs prior to coating, manufacturers ensure optimized production yields, throughput and quality, and also avoid the major costs of coating removal and PCB reworks. It is essential to work with a critical cleaning partner that has specialized expertise in PCB cleaning and drying. They can recommend the best cleaning and drying methods that will work best to ensure conformal coating success and PCB longevity and performance.

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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