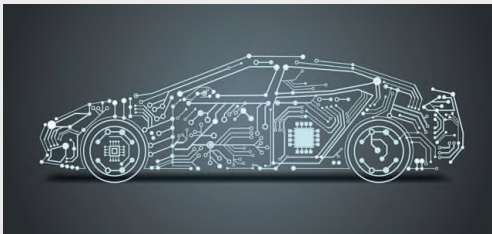


Cleaning: The Driving Force Behind Reliable Automotive Electronics

- **Author:** Emily Peck, MicroCare Senior Chemist
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Modern vehicles are packed full of complex circuitry and miniaturised PCBs



Contaminant includes white residue left behind after soldering the PCB



The use of electronics within the automotive sector is rapidly increasing and evolving. What was once centred on mechanical machines is shifting to electronics. These systems are now the heart of modern vehicles and will continue to be as the industry pushes ahead with autonomous and intelligent transport systems.

As electronics play a bigger role, the importance of ensuring these systems work reliably becomes even more important. Modern vehicles are packed full of complex circuitry and miniaturised PCBs which will increase as technology and applications advance within the automotive industry. This brings with it, consistency concerns. These PCBs have to work, and work well. They must perform without fault and have long-term reliability. Not only is this assurance important in order to stay competitive in a fierce marketplace, but it is essential to safety. It can however be extremely challenging to achieve because of the small size and difficult geometries of the PCBs and assemblies used to operate these systems.

Let's not forget there is also the added challenge of having to withstand extremely harsh conditions over long periods of time. Every day, vehicles face excessive temperatures, high humidity, salt-spray, gasoline vapor and constant vibration. Conformal coatings are critical to protect PCBs from these environments and ensure long-term reliability. They protect the delicate circuitry and electrically insulate the components from environmental stresses. What is key to remember is that cleaning before conformal coating is critical to its successful application and to the reliability of the PCB.

Clean Conformal Coating

One of the main causes for PCB failure is contamination, therefore, cleaning is advised whether it is conformal coated or not as the process will increase reliability. Any contaminant can negatively affect the PCB's dependability and can lead to a number of problems from electrochemical migration and delamination, to parasitic leakage, dendrite growth and shorting. Contaminated boards can also severely affect conformal coating effectiveness and in turn PCB reliability.

Contaminant can include simple dirt, dust or oil from a fingerprint, to ionic contamination like flux residue, or 'white residue' left behind after soldering the PCB. Ionic contamination normally consists of inorganic salts or acids and contains molecules that are conductive when in a solution. If conformal coating is not effectively applied to form a moisture barrier, the ionic residue can split into negatively or positively charged ions increasing the overall conductivity of the solution. Any small voids in the PCB conformal coating can expose the PCB and gradually degrade its components.

Any particulate left on the board can also inhibit bonding of the conformal coating to the PCB substrates. If PCBs are not effectively cleaned before applying the conformal coating layer, defects may occur. These can include uneven coverage, pinholes, bubbles and craters. It is also important to be aware that flux residue on the PCB can absorb and trap moisture which is released during the coating curing operation. The coating can then separate from the board, allowing corrosive materials, dust, or water from the end-use

Tech Article



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



Vapor degreasing with modern, sustainable cleaning fluids delivers the highest quality of cleaning in the most cost-effective and time-efficient way



environment to enter the PCB assembly. This can cause board corrosion, dendrite growth, parasitic leakage, signal loss or complete PCB malfunction. To prevent performance problems, residue-free cleaning prior to conformal coating is critical.

Choosing an Effective Cleaning Process

Cleaning prior to applying conformal coatings will go a long way in eliminating reliability issues. But the question is – what is the most efficient and effective method to clean a PCB? It must be a sustainable, efficient, cost-effective and consistent method. It must also be able to effectively clean multifunctional and complex low standoff electronic components like flip chip, micro BGA, MOSFETs and QFN packages all tightly packed on to miniaturised boards. If every millimetre of the PCB is not cleaned well, reliability is at risk.

Vapor degreasing can assist in the cleaning challenge faced by vehicle manufacturers. As a tried and tested application, vapor degreasing has many benefits. It uses solvent immersion, combined with vapor rinsing and drying to remove all types of oil, flux and particulate.

A vapor degreaser is a cleaning process that encompasses a closed-loop system. Basic systems contain a top-loading container composed of two chambers or sumps, both filled with cleaning fluid. In one chamber, the fluid is heated to a boil, which then generates a vapor layer that rises to meet two sets of cooling coils. These cooling coils cause the vapors to condense and return to their liquid state. This liquid is then channelled back into the vapor degreaser for reuse.

A hoist lowers a basket containing the contaminated components through the vapors and into the boil sump first. The basket is then lowered into the rinse sump containing the clean solvent that has been condensed from the vapors. This process is easily programmable and allows for excellent process control and repeatability. The parts come out clean, dry, and immediately ready for further processing like the application of a conformal coating layer.

The cleaning fluid used within a vapor degreaser also has a significant effect on PCB cleanliness. The low-boiling cleaning fluids have multiple properties that are advantageous to critical cleaning. For example, they have a low surface tension and a very low viscosity, therefore they easily penetrate and clean even the tightest of spaces and under zero clearance components. They not only penetrate these areas, but they also completely flow out and away from the components, taking any contaminant and residue with them. Most vapor degreasing fluids also are very heavy and dense, typically 20-40% heavier than water, which aids in dislodging particulate from the components. Because the cleaning fluid is engineered for specific applications, delicate parts are easily cleaned and dried making it the ideal cleaning process to use before conformal coating.

Vapor degreasing systems can be extremely cost-effective because the cleaning fluid is re-used many hundreds of times. As an additional, and important benefit, modern cleaning fluid is a non-flammable, non-toxic, environmentally-acceptable

cleaning option that is completely ozone-safe and meets strict regulatory conditions.

Look to the Future

When properly designed, equipped and configured, vapor degreasers outperform the cleaning efficiency of other cleaning technologies, making them the most adaptable option when it comes to guaranteeing precision cleaning processes. PCBs used within vehicle electronics must be reliable, therefore they must be cleaned effectively to ensure contamination does not interfere with important applications like conformal coating.

The optimal PCB cleaning process needs to dissolve or displace common contaminants in a quick and effective manner. Vapor degreasing with modern, sustainable cleaning fluids delivers the highest quality of cleaning in the most cost-effective and time-efficient way. To ensure PCB reliability and safeguard long-term functionality, always clean effectively.

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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