



# **CHOOSING CONFORMAL COATINGS FOR MISSION CRITICAL PRINTED CIRCUIT BOARD ASSEMBLIES**

**Qualitel** 

When we think about the lifecycle of the electronics products we produce and the abuse they take, whether industrial or mission critical medical, aerospace or defense, we and those who count on our products have a lot riding on ongoing performance. Environmental stresses and contaminations such as water, salt, dust, solvents and chemicals can play havoc with operations, durability, integrity and warranties.

In these cases the best defense is a good offense; doing all that can be done to protect sensitive printed circuit board assemblies (PCBAs) from the rigors of projected use and environmental hazards. The most actively used protection is conformal coatings.

## CONFORMAL COATINGS & CONSIDERATIONS

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Conformal coating is a process where PCBAs are coated for protection from a number of stressors, and the term actually refers to a number of different coatings. Selection of a particular coating must be made by balancing the unique capabilities of the individual coatings, the process of application and cost versus the use of the PCBA and what it must be protected from.

The ideal conformal coating would provide a barrier against all possible environmental or user-induced effects. It should be able to withstand wide temperature influences and contamination from numerous sources, and still not disrupt the function of the circuit board. In addition, it may need to be hard enough to withstand abrasion yet soft enough to occasionally be removed for PCB repair or warranty work; thick enough to do its intended job yet thin enough to not alter the space and production requirements during insertion into larger assemblies or products. Coatings should also be able to easily flow in and around close components without pinholes or weak spots. Application considerations also compound the difficulties of finding the perfect, one-size-fits-all coating. Do areas of the circuit board need to be masked off or can it all be covered? What about drying times, temperatures or component stress during application?





Science is getting close to creating the perfect, all-around conformal coating and over time some types have emerged as front-runners, but for now choices and tradeoffs still need to be made. Currently there are four conformal coatings that are in common use, each with specific characteristics appropriate for the PCB's duty, placement and industry specifications. Those four are:

- **Acrylic**
- **Urethane**
- **Potting**
- **Parylene**



*Parylene coating machine*

## ACRYLIC CONFORMAL COATINGS (TYPE AR)

Acrylic conformal coatings are low in cost and are used for moisture-humidity resistance and reliable dielectric/insulative properties while offering good adhesion and coating characteristics. But for many applications it does not always offer the best solution. For example, acrylic cannot withstand to most solvents/chemical or isopropyl resistant along with having poor thermal cycling ability - the ability to withstand vast temperature extremes and rapid changes. The application process can cause stress to the PCBA and require temperature cure time to speed up cure times. Still, acrylic conformal coatings do have their place, particularly if warranty or field work may be required down the road with ease of coating removal with isopropyl alcohol..



*Parylene Coating Laser*

## PARYLENE CONFORMAL COATING

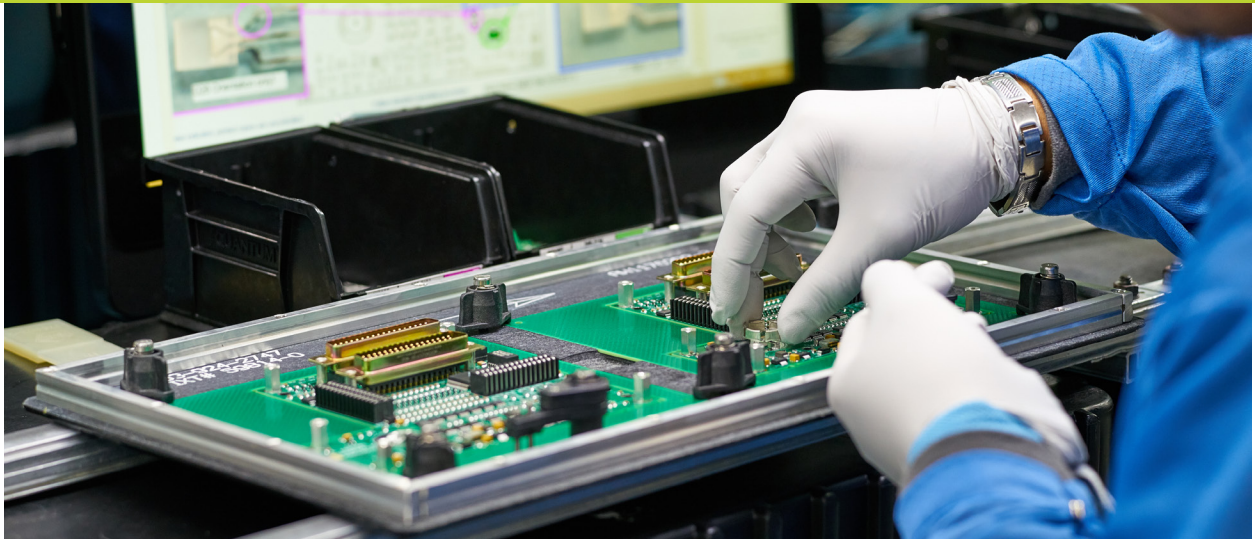
Parylene has become the workhorse of conformal coatings. It makes up for many of the gaps in other coatings and has many additional attributes of its own. Parylene provides great protection under most environmental conditions with no cure time, making its application extremely fast during prototype tests or large production runs. It is a very thin coating allowing its placement extremely reliable around compacted subcomponents or in tight spaces with no pinholing. Because of this and its excellent adhesion, it is contraindicated where repair or warranty work may need to be a concern. But other than this its formidable properties more than make up for this one possible pitfall. Parylene offers superior chemical, solvent and water resistance without any of the application problems that arise in most conformal coatings. There is no application stress to the PCBs and no cure time. The result is a very stable, hydrophobic coating for mission critical applications. The coating is applied with vapor deposition, which requires specialized equipment and a bit of added cost, but for most the advantages and value added far outweigh the slightly added expense.

The only real concern with Parylene coatings is that very few manufacturers offer it as part of the prototype or production process. So, when a PCBA is completed it typically has to be shipped to third party, inviting delays, extra costs and the possibility of damage during transit and handling. Still, this coating has become the standard bearer by which all others are measured.

# SUMMARIZING CONFORMAL COATINGS

	Advantages	Disadvantages
<b>Acrylic</b>	<ul style="list-style-type: none"> <li>• Basic Level Protection</li> <li>• Good Moisture -Humidity Resistance</li> <li>• Good Dielectric Strength</li> <li>• Coating removal is easy</li> </ul>	<ul style="list-style-type: none"> <li>• Poor Chemical Resistance</li> <li>• Poor Solvent Resistance</li> <li>• Fair Thermal Cycling</li> <li>• Long Cure Times w/o additional equipment</li> <li>• Thicker and Less Uniform than Parylene</li> </ul>
<b>Urethane</b>	<ul style="list-style-type: none"> <li>• Durable and Rigid</li> <li>• Good Chemical Resistance</li> <li>• Abrasion Resistance</li> <li>• Coating removal is possible with chemicals</li> </ul>	<ul style="list-style-type: none"> <li>• Long Cure Times w/o</li> <li>• Additional Equipment</li> <li>• Thicker and Less Uniform than Parylene</li> </ul>
<b>Potting</b>	<ul style="list-style-type: none"> <li>• Complete Encasement</li> <li>• Good Electrical Properties</li> <li>• Suited for High Production</li> <li>• Impact Resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Added Weight &amp; Thickness</li> <li>• Repair is Not Possible</li> <li>• Require tooling for potting</li> </ul>
<b>Parylene</b>	<ul style="list-style-type: none"> <li>• Exceptional Protection in Extreme Environments</li> <li>• No Cure Time</li> <li>• UltraThin Coating with no Pinholing</li> <li>• Uniform coating</li> <li>• Extreme Chemical and Water Protection</li> <li>• The New Standard for Conformal coating</li> <li>• Repair is possible</li> </ul>	<ul style="list-style-type: none"> <li>• Slightly Higher Cost</li> <li>• Difficult to Find a Manufacturer of PCBAs That Provides the Coating</li> <li>• Repair is more difficult</li> <li>• Additional masking required</li> </ul>





## QUALITEL CONFORMAL COATING CAPABILITIES

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Unlike many PCB manufacturers, Qualitel offers all four types of conformal coatings, and their engineers can help you select the right choice to meet your specifications. Within the selection of acrylic, urethane, potting and parylene you'll be able to enhance the reliability of your PCBA for industrial, medical or defense and aerospace mission critical applications.

It needs to be noted, however, that Qualitel is one of the few PCB manufacturers in the nation and the only one on the west coast that offers parylene coatings as part of the prototype or large production run process. This not only saves the time and the cost involved in finding a third party vendor to apply the conformal coating, but it adds an element of quality control as well; less chance of damage or contamination because of additional, unnecessary shipping.

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