

PCB Conformal Coatings Guide - I

Printed circuit boards are the base of electronic products in a variety of consumer and industrial applications. New PCBs always perform well. However, their performance will deteriorate with time due to exposure to different environmental conditions like condensation, moisture, contamination of the iconic material on the surface, dust and dirt, mildew, alpha particles, etc. To avoid these problems, [PCBs are protected with conformal coatings](#). Let's see how this is done, and how they protect PCB components.

Understanding How Conformal Coatings Work

Conformal coating is a layer of polymer film, or chemical coating that is sprayed over a PCB board to protect it from harsh environment conditions. These coatings exhibit high electrical insulation, and help maintain Surface Insulation Resistance (SIR) levels of the PCB board. It allows any entrapped moisture to escape from the circuit board. Also, it creates a barrier for most air-borne contaminants such as salt-spray, thereby preventing corrosion.

Types of Conformal Coating Resins

Following are the five main types of conformal coatings:

- **Acrylic (AR):** These coatings are the most popular in this category. These acrylic coatings are easy to apply, and remove. Acrylic coatings exhibit high corrosion, and abrasion resistance, high dielectric strength, and chemical resistance.
- **Silicone (SR):** These coatings can work well across wide temperature ranges. Silicone coatings provide immense resistance against chemicals, salt sprays, etc. These coatings are the most flexible on this list.
- **Polyurethane (UR):** The polyurethane conformal coatings offer high chemical, moisture, and abrasion resistance. They also exhibit high resistance against solvents.
- **Epoxy (ER):** These coatings are usually available as two-part compounds, and offer very less flexibility. Epoxy coatings provide high abrasion, chemical, and humidity resistance.
- **Parylene (XY):** These coatings exhibit excellent dielectric strength. The parylene coating is ideal for PCBs that experience extreme temperatures, and come in touch with chemical solvents. The XY coating is applied through vapor phase deposition.

Methods of Applying Conformal Coatings on PCBs

Conformal coatings are applied to PCBs in any of the following ways:

- **Batch Spraying:** Conformal coating is applied by a handheld spray gun, or an aerosol can. This method is ideal for low volume production, when capital equipment is unavailable.

- **Chemical Vapor Deposition:** This method is applicable for parylene conformal coatings. In this method, parylene is heated first, and allowed to cool. Later, gaseous vapors are introduced to a gaseous chamber, where they polymerize to form a film, which is coated on the entire PCB. This process requires intensive training, and is usually conducted under the guidance of experts.
- **Robotic Coating:** This is an automated process that uses robotic spray nozzles to conformally coat specific areas on the circuit board. This method is suitable for high volume applications.
- **Dipping:** In this method, PCBs are immersed in conformal coating concentrates and then withdrawn. The viscosity of a conformed coating will depend on immersion speed and time as well as withdrawal.
- **Brushing:** This is a simple application employed in repairing PCBs. In this method, the coating is applied on the PCB using a brush. This method is suitable for small production runs.

In the next post, we will discuss different curing and drying methods, and benefits of conformal coatings.