TECHtips

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Electronics Manufacturing Insights from ACI Technologies, Inc.

Coating Application Methods

Conformal coatings are applied to Printed Circuit Board Assemblies (PCBAs) using a variety of different methods. There are six main methods of applying conformal coatings[1]: manual spraying, automated spraying, dipping, brushing, selective coating, and vacuum deposition.

Manual spraying is a common practice for a process where a high mix is employed, where low volumes are produced, a low cost process is desired, or where the expectation exists for frequent design changes (such as early prototype production). The biggest problem with manual spraying is inconsistency from one operator to another, which may require hand touch-up by brushing. Spraying requires the use of sufficient ventilation due to the high solvent content typical of aerosols as well as the typically low flash point of the solvents. This combination can create a fire hazard if the solvents are allowed to build up in the spray area. Depending on the solvent used, respiratory equipment may be required for the operator.

PCBAs should be sprayed in the horizontal position to help ensure a consistent thickness across the assembly. Masking may be required if any keep-out areas exist. In order to ensure a consistent application, assemblies should have a thin coating applied during each pass and then be rotated 90 degrees between each spray.

Manual spraying can be further subdivided into aerosol spraying and handheld gun spraying.

- Manual aerosol spraying (Figure 1) is analogous to graffiti painting. It has a low startup cost – all it requires is a ventilated area, a few cans of coating, and an operator – but efficiency is a concern as there is a significant loss of coating (40% or more) due to over-spray and spray of masked areas.

- Handheld gun spraying (Figure 2) is similar to auto body shop painting. The process has a finer degree of control of variables (fluid and air pressure) when compared to aerosol spraying. Another advantage is the ability to use coatings with higher viscosities than can be used with aerosol techniques. A disadvantage is that coating may begin to cure in storage, especially coatings that use moisture as a cure catalyst. If curing occurs in the system, the clean up can be quite difficult. The use of pressurized dry air or nitrogen in the storage tank can prevent this from occurring.

Figure 1: Manual aerosol spraying.

Figure 2: Handheld gun spraying.

Automated spraying (Figure 3) refers to a reciprocating spray system in a process that is like applying icing to donuts. Parts on a paper belt move directly under a reciprocating spray head that applies the coating. Machines of this type may incorporate ovens directly after the spray area. The oven is used to cure the parts to a state where they can be handled without concerns about tacky coating. Masking is still required as the spray head continuously coats the belt and everything on it while the machine is running. Through control of variables (fluid and air pressure, belt speed, spray reciprocating speed), the required skill of the operator is reduced and the process can achieve better uniformity than a purely manual application method.

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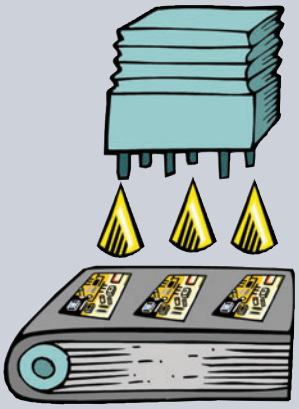

Figure 3: Automated spraying.

Dipping (Figure 4) is the coating method of choice for many high volume processes and is similar to making chocolate covered strawberries. It is an efficient method with very little wasted material. Dipping also has good repeatability once properly set up and controlled. The main variables that are the immersion speed, withdrawal speed, dip dwell time, and coating viscosity. Immersion speed is set to ensure that the coating can displace air around components as they are dipped into the bath. The dwell time should be set so that all bubbles have stopped. The withdrawal rate is set to a slower speed than immersion and to a speed that provides for the proper coating thickness as the PCBA is removed from the bath. The viscosity is controlled by adding solvents to the storage tank to ensure operation within the recommended application range.

Figure 4: Dipping.

Brushing (Figure 5) is a low-cost, labor intensive application method that uses a brush to apply the coating to the PCBA surface similar to how Picasso would have applied oil paint to canvas. Brushing is most often used for repair and rework applications, where the originally applied coating needs to be replaced or supplemented. It can be difficult to cover an entire PCBA of any reasonable size with a consistent thickness by brushing. This method benefits from a reduced need for masking, as the operator can carefully control the specific locations where coating is required. The use of an open air container requires care to prevent materials from curing or changing viscosity on the workbench by using the proper solvents with the material.

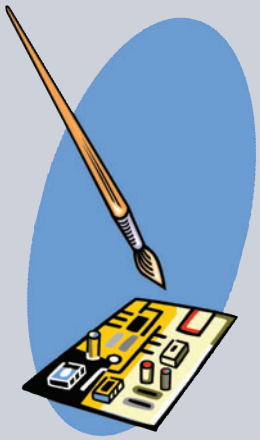

Figure 5: Brushing.

Selective coating (Figure 6) is an automated coating process that is similar to painting in an automotive assembly factory. Instead of a reciprocating head as described in the automated spraying process, the selective coating process uses a programmable robot outfitted with a spray nozzle and programmed to spray the exact locations required. Depending on the precision of the spray nozzle and the accuracy of the robot, the need for masking can be reduced or eliminated. This process lends itself to a high degree of control, resulting in a very repeatable process.

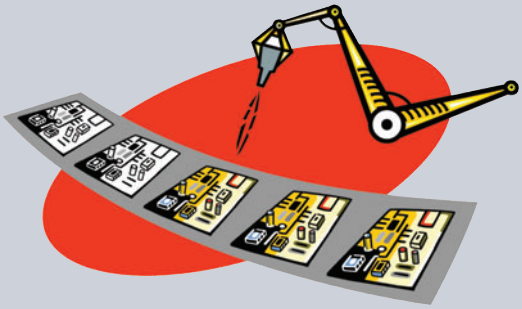

Figure 6: Selective coating.

The final coating application method uses Chemical Vapor Deposition (CVD), a vacuum deposited coating process. Used only for Type XY poly (para-xylylene) or Parylene, this process requires special equipment and training but provides an extremely accurate and consistent application. Like the Mythbusters say, "Do not try this at home, unless you are a trained professional." Expect to invest heavily for this technology or let experienced subcontractors handle the job.

When assessing a need to apply conformal coating, each of the methods described can be suitable in the right situation. It is up to the technician or engineer to determine whether you need to be a graffiti artist, a body shop painter, a donut shop, a candy maker, Picasso, an automotive factory paint shop, or a Mythbuster. Many of these techniques are available at ACI Technologies. For more information, please visit www.aciusa.org or call the technical staff at 610.362.1320.

Reference:

1. IPC - Association Connecting Electronics Industries. IPC-HDBK-830 "Guidelines for Design, Selection, and Application of Conformal Coatings". Oct. 2002, 28 - 33.

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