

SMT *onLine...*

Reworking Silicone Conformal Coatings

By *Marjorie Dwane and Barry Ritchie, Dow Corning Electronics and Advanced Technologies, Dow Corning Corporation*

Conformal coatings — generally one of the last production processes performed on a PCB — continue to see increased usage and popularity. An inexpensive method of providing corrosion protection to electrical assemblies used in high-humidity environments, they are applied to PCBs for various reasons: to protect from moisture and contamination, to minimize dendritic growth and provide stress relief, and for insulation resistance. These contribute to more durable handling, enhanced device reliability, and reduced warranty costs.

However, a faulty component may be found in final testing following the coating process. In that event, silicone conformal coatings provide a performance advantage over other coating options in their inherent reworkability. Silicone coatings, unlike hard organic chemistries, are soft, flexible materials that provide moisture resistance and stress relief. Their low durometer enables the use of various removal options. The complexity of the components to be reworked will determine the most appropriate method for removal. Knowing your removal and repair options upfront and how to choose between them can save time, money, and frustration.

In some cases, expensive components can be removed and the rest of the board simply discarded. Frequently, however, there is considerable cost associated with the populated PCB, and it is preferable to salvage the board by removing the coating and replacing the faulty components. Some PCB assemblies (PCBAs) — laptop motherboards, a plasma TV's video driver board, aircraft avionics — can cost hundreds, even thousands of dollars. Two primary rework scenarios need to be considered: removing the coating in local sites to replace components, and removing the entire coating from all areas of the PCB.

Local Repairs

To perform this type of procedure correctly requires a “surgical technique” of rework operators. A comprehensive plan for removing the conformal coating ensures no collateral damage is done to the underlying substrate or to other devices or structures in close proximity to the rework site. Several methods can be used to assist in removing the coating. These include chemicals or solvents, micro-abrasives, mechanical steps, and de-soldering through the coating.

Chemical or Solvent Removal The success of this common method depends on the type of conformal coating chemistry being removed and the particular solvent chemistry. In most cases, solvents will not actually dissolve the conformal coating, but will cause it to swell. Once this has been achieved, the coating can be easily removed by gently scraping or using light abrasion. Silicone strippers* will dissolve the coating, but care must be taken to ensure that the selected chemical does not damage the substrate and adjacent areas.

The key for this method is keeping the solvent where it is needed. One technique is to use a temporary material to create a dam around the target component. This should keep the solvent or stripper in the designated area, although some solvent may still leak under the dam. Another approach is to

add filler to the solvent to produce a paste. Silica, fumed silica, or sodium bicarbonate powder are suitable fillers. In some cases, a combination of removal techniques may be required. The methods and techniques included in this article meet the guidelines contained in IPC-HDBK-830 for conformal coating rework and repair.

Once the component has been de-soldered and removed, all solvent or stripper must be eliminated to prevent interference or dissolving the new coating. The solder pad sites also should be cleaned to facilitate good adhesion when the replacement device is attached. After soldering the device back onto the board, remove residual solder flux with solvent cleaner.

Micro-abrasive Removal This method, which requires excellent dexterity, uses high-velocity particles shot through a nozzle, as shown in Figure 1. Commonly used abrasive media include ground walnut shells, glass or plastic beads, and sodium bicarbonate powder. When used silicone coatings, care must be taken so that the abrasive media does not embed itself into the soft surrounding coating. Mask the surrounding areas with aluminum foil or plastic. Damaging static charges can be generated as high-velocity particles travel through the lines, so many micro-abrasion systems have anti-static ionizers and grounding points contained within the unit.

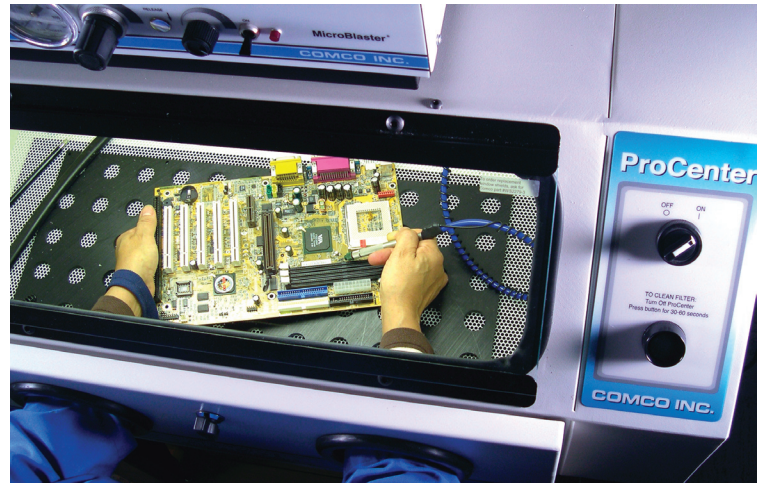


Figure 1. Micro-abrasion techniques require skill and dexterity to remove coatings from selected locations. **

Mechanical Removal Although this is perhaps the least preferable method, it can be the easiest. A multitude of equipment rework stations containing drills, grinders, rotating brushes, and the like are available commercially.*** Start by removing the coating fillets surrounding the solder joints to be reworked. These often have the thickest coating build up and can be 20+ mils thick. A gentle V slice over the targeted solder joints with a fine blade or scalpel suffices.

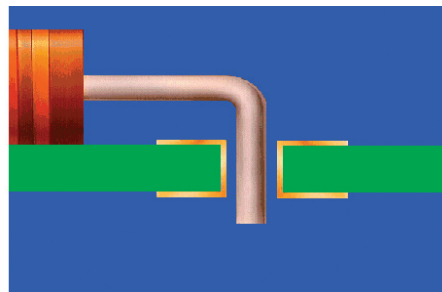
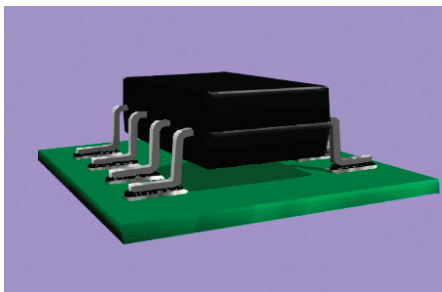


Figure 2. Surface mount components (l) are easier to remove, due to attachment to only one side of the PCB. Thru-hole (r) rework requires coating removal on both sides of the PCB.

component de-soldered. Demarcation edges should be trimmed of the partially dissolved edges. For solder-side areas in the case of thru-hole components, use a fine blade to rupture the integrity of the coating directly over the solder fillet, allowing the solder to flow easily when heated with a vacuum de-soldering tool.

De-soldering through the Coating De-soldering techniques can sometimes be used to burn through or degrade conformal coating. Start by creating a vent hole in the coating fillet to allow molten solder to evacuate. To prevent delamination of the solder pad or damage to the solder mask, be careful of

coating fillets surrounding the solder joints to be reworked. These often have the thickest coating build up and can be 20+ mils thick. A gentle V slice over the targeted solder joints with a fine blade or scalpel suffices.

Solvent or stripper can then be injected into the groove, and should not migrate to other sites. Once swollen, the remaining coating is extracted with forceps and the component

overheating the site. Adequate ventilation will dissipate any fumes generated by the coating's thermal decomposition.

Surface Mount vs. Thru-hole Components Surface-mount components are generally only attached to one side of the PCB. This makes rework much easier because coatings need only be removed on that side. Thru-hole technology, on the other hand, requires double-sided removal before components can be reworked.

Removing All the Coating From a PCB

When all coating must be removed from both sides of the board, it must be fully immersed in a solvent or solvent/stripper. Because liquid conformal coatings do not always coat everything uniformly, due to capillary action and fillet formations around vertical components, thinner areas separate first. Several hours of immersion may be required. Heating the solvent or stripper can decrease dwell time, but introduces a risk of igniting flammable solutions or their vapors.

Recoating Rework Sites

Because many silicone coatings do not adhere well to themselves, it is strongly recommended that only one-part moisture-cure silicone coatings be used for repair and rework. The optional use of a primer, or gentle roughening of the surface, can improve adhesion. Before touching up the solder joints of a rework site with new conformal coating, however, it is imperative to thoroughly clean the coating surfaces. When recoating with a brush or syringe, overlap the new coating with the original coating demarcation edges by at least 3 mm.

Conclusion

Removal and rework procedures for component replacement should be considered before a conformal-coating chemistry is chosen. Ideally, rework procedures should be defined as part of the original board design. All too often, however, conformal coating is an afterthought, and left off design criteria. Sometimes it may be more cost effective to scrap the circuit board, but when costly assemblies and components must be salvaged or repaired, one-part moisture-cure silicone conformal coatings are strongly recommended.

A successful removal and rework strategy should include procedures to remove the coating, de-solder, replace faulty components, and then re-coat the area with new material. Although the goal is to minimize or eliminate rework costs, it is important to understand that in some instances multiple procedures may be required to remove and repair conformal coatings. Each rework scenario will have its own requirements, and there is no single fix-all procedure.

* SU-100 from Silicones Unlimited

** Microblaster from Comco Inc.

*** A common example is from Pace Inc.

Marjorie Dwane is the Global Market Manager for Electronics Protection within the Electronics and Advanced Technologies Business for Dow Corning Corporation.

Barry Ritchie is a senior field application engineer for the Application Engineering Center within the Electronics and Advanced Technologies Business at Dow Corning Corporation.

For more information, contact electronics@dowcorning.com.