Diagnosys

Conformal Coating Removal Study

CONFORMAL COATING REMOVAL TECHNIQUES

Why use Conformal Coating?

Conformal coatings are thin layers of synthetic resins or plastics that are applied to electronic devices for protection against a variety of environmental, mechanical, electrical and chemical problems, such as:

- Humidity and moisture
- Fungus and mildew
- Dust and dirt
- Alpha particles
- Stress
- Mechanical shock and vibration
- Thermal cycling
- Corrosion
- Process solvents, fuels, hydraulic fluids, other fluids
- Adds Dielectric strength

While most conformal coatings are used on printed circuit boards (PCBs), they are also used to protect discrete components, such as transistors, diodes, rectifiers, resistors and LED's; integrated circuits (ICs); and hybrid circuits, including multi-chip modules (MCM) and chip on board (COB).

Types of Industries that use Conformal Coatings

Originally developed for military, aerospace, and marine applications, conformal coatings are now finding widespread use in telecommunications, industrial controls and instrumentation, consumer electronics, and the automotive industries. All applications in which product reliability and protection are of primary importance.

Types of Conformal Coatings

Currently six major types' conformal coating chemistries are available:

- ◊ Epoxy
- ◊ Acrylic
- ◊ Urethane
- ◊ Silicone
- ◊ Parylene

- ◊ Ultraviolet-cured materials

We recently took a survey of our Industry contacts and found the following percentages for usage of conformal coating types:

Urethane	62%
Silicone	47%
Acrylic	45%
Epoxy	37%
Parylene	21%
Others	11%

The percentages equal more than 100% because several companies are using more than one type of conformal coating.

The military specification for coating printed circuit assemblies, MIL-1-46058, recognizes 5 types of conformal coatings:

- ♦ Type AR (acrylic) - Acrylics are easy to apply conformal coatings that are not that resistant to abrasions and chemicals.
- ♦ Type ER (epoxy) - Epoxies are fairly easy to apply and very hard to remove.
- ♦ Type SR (silicone) - Silicone conformal coatings are for high temperature environments.
- ♦ Type UR (urethanes) - Polyurethane's are the most popular conformal coatings, offering humidity, chemical and abrasion protection
- ♦ Type XY (parylene) - Paraxylylene is a vacuum deposited conformal coating. They offer excellent resistance to humidity, moisture, abrasion, high temperatures and chemicals.

Ultraviolet Cured Materials

In the early 1980s, when regulations started to be applied against volatile chemicals, an immediate need existed for solvent less conformal coating materials. Conformal Coating manufacturers responded by developing ultraviolet (UV) curable conformal coatings. This helped eliminate air pollution and save energy by no longer requiring drying or curing after coating. Solvents were successfully developed from epoxy acrylates, urethane acrylates, and polyester acrylates.
Ultraviolet (UV) cured materials are also recognized, but are not listed as a separate group. They are included within the above five categories. While each of these coating types exhibits properties that make it the best choice for a particular application, special attention should be paid to the techniques used for their removal.

The Removal of Conformal Coatings

Now let's take two examples of what can happen.

1. You are a manufacturer of PCB Assemblies. You have just finished your production run and your engineering department comes down to the production floor and has a mandatory change that requires you to replace 2 components, on 500 boards.
2. You are a repair organisation and you need to make contact with components in able to functionally test them and diagnose the faults on the board.

What technique are you going to use? Luckily you have several options available to you. They include **thermal**, **mechanical**, **chemical** and **abrasive**.
Again, we recently took a survey on the different techniques used by the companies and the results were:

Chemical	62%
Mechanical	53%
Thermal	32%
Abrasive	28%

Again, the percentages equal more than 100% because people are using different techniques to remove the conformal coating.

Thermal

The thermal removal technique (including using a soldering iron to burn through the conformal coating) is the least recommended technique of coating removal. Most conformal coatings require a very high temperature and/or long exposure times. This, in turn, can cause discoloration, leave residues, and adversely effect solders and/or other materials used in the construction of the board or its components. Thermal removal can cause the lifting of surface mount pads from boards. Also, temperature-sensitive components may be damaged. Extreme caution must be taken when burning through conformal coating because some coatings emit very toxic vapours that are hazardous to the people doing the stripping and those around them.

Mechanical

Mechanical removal techniques include cutting, picking, sanding or scraping the area of coating to be removed. However, most of the conformal coatings are very tough and abrasion-resistant, making the probability of damage to the board very high.

Chemical

Until a few years ago, chemical removal techniques were the most popular techniques for the removal of conformal coatings without adversely affecting the board or its components. However, there is no one perfect solvent for all applications, and in some cases no solvent will be suitable at all.
Of course, the first problem faced by anyone who must remove a conformal coating is determining the composition of the coating that is to be removed. If information concerning the nature of the coating is not included in the product literature, the only recourse is to contact the manufacturer and ask.

Choosing a Solvent

When choosing a solvent for the removal of a particular conformal coating, you should examine the following criteria:

1. Does it quickly and completely remove the coating?
2. Does it selectively remove the coating while not damaging or adversely affecting the substrate and/or other components or devices?
3. Is it safe to work with?
4. Is it environmentally acceptable?

Since regulations vary not only from country to country, but also from company to company, the answer to some of these questions can only be determined by the individual company.

Abrasive (Conformal Coating Removal Workstations)

The first machines used for conformal coating removal were small sandblasting machines that were originally designed for metal deburring and etching[2]. Little or no consideration was given to the inherent problem of electrostatic discharge (ESD).

How a Conformal Coating Removal Machine Works

Basically, a cutting media is introduced into a compressed air stream and ejected through a hand held nozzle. This is directed at a component on a printed circuit board that has a conformal coating applied to it that you want to remove.

Cutting Media's

In the beginning, different types of cutting medias were offered to customers but no extensive testing or conclusions were given to industry because the manufacturers of the sandblasting equipment made most of their profits on selling cutting media.

Biological media such as wheat starch and walnut shells had the best results for stripping the conformal coating but had very high generated ESD voltages, in some applications higher than 25,000 volts at point of contact. (Note: Point of Contact is were the cutting media strikes the board). Small sandblasters will remove the conformal coating from

printed circuit boards with efficiency. However, there are several things you should be concerned about before you decide to use this technique.

Types of Cutting Media

The right type of cutting media goes along way in eliminating the ESD problem. There are several types of cutting medias available, some of them ESD friendly and others are not. The correct media is the one that will best do the job for your application and not be ESD unfriendly.

- **Aluminium oxide** is a very aggressive media that can cut right through a printed circuit board. Typical ESD reading range for aluminium oxide is in the 500v to 1,000 volt range.
- **Biological medias** (wheat starch and walnut shells) are not as aggressive as aluminium oxide but they usually leave a residue that must be cleaned off prior to re-coating. These medias are **not** ESD friendly with voltage levels exceeding 25,000 volts in many cases.
- **Sodium bicarbonate** is a popular media but it generates high ESD levels and it also must be thoroughly cleaned off the board before reapplying a coating.
- There are several types of **plastic cutting medias** available. These have the lowest ESD generated levels, if formulated correctly, and they are also recyclable.

The ESD Problem

Conformal coating removal machines have an inherent problem. They generate static electricity. They can't help it; it's the nature of the beast. As you probably already know, ESD will kill the board you are trying to repair unless you take extreme care. Table 1 shows the ESD voltage levels that will cause damage to individual component types.

Table 1 - Reported Susceptibility Ranges of Various Devices Exposed to Electrostatic Discharge From a Person or Electronic Equivalent[3]

Device Type	ESD Susceptibility Voltage Range
VMOS	30 -1,800
MOSFET	100 - 300
GaAsFET	100 - 300
EPROM	100
JFET	140 - 7,000
SAW	150 - 500
OP-AMP	190 - 2,500
CMOS	250 - 3,000
SCHOTTKY DIODES	300 - 2,500
FILM RESISTORS (THICK, THIN)	300 - 2,500
BIPOLAR TRANSISTORS	380 - 7,000
ECL	500* - 1,500

SCR	580 - 1,000
SCHOTTKY TTL	1,000 - 2,500

* PC board level

Solving the ESD Problem

Because conformal coating removal machines are static generators, the different manufacturers or conformal coating removal systems have taken several different approaches to solving the ESD problem. Some manufacturers install AC or DC pulsed ionizer bars in the work chamber as a modification and solution. The main concern with these ionizer bars is they can go out of adjustment and thus have to be continually adjusted to remain within specifications. One manufacturer has installed a point ionizer on the end of their nozzle to try to dissipate any static charge built up in the media stream at point of contact. Another manufacturer has taken an entirely different approach to the ESD problem.

This different approach begins in the media stream were the ESD is generated. By incorporating the latest technology, in-line, auto-balanced ionizer, the media flow path changes. By splitting the air source, with one air path going to the media chamber and the other going to the in-line ionizer, the ionized air is injected into the media stream just before it leaves the nozzle. This eliminates the static charge built up in the media chamber. The ionized air is also pumped into the work chamber. With this system, ESD readings are typically in the ±10v range.

Techniques vs. Type of Coating

In the following sections, we will explore the different conformal coating type by the different removal techniques for each. We will also discuss the differences between spot removal and removing the conformal coating from the entire board and try to determine the time it will take for each. Finally, we will explore the clean up requirements for each.

Polyurethane's

Offering good dielectric properties, with excellent humidity, abrasion, and chemical resistance, polyurethane conformal coatings are the most cost-effective and widely used coatings.

Thermal

This is the one area you **DO NOT** want to use the thermal or burn through technique. Polyurethane's will emit a toxic gas that in time will cause great damage to your employees.

Mechanical

Because polyurethane is so hard after it sets up, this technique is not recommended. Damage to the board most likely will occur.

Chemical

Currently available for removal of polyurethane coatings are several solvents that provide a wide range of speed and selectivity that can be matched to a specific application.

These solvents include: methanol base / alkaline activator solvents, which are the slowest and most selective; other methanol base / alkaline activator solvents that are somewhat faster acting and are the most popular; and ethylene glycol ether base / alkaline activator solvents, which are the fastest and least selective.

Complete removal of the coating is accomplished by immersion of the board into the solvent at room temperature. The amount of time required for coating removal will vary with the solvent being used, the particular coating used, and coating thickness. Typically, most polyurethane coatings of 0.004 inch thickness can be removed in one to three hours.

The use of ultrasonics or any agitation of the solvent will help to reduce the time required. The board should be removed from the solvent periodically; if it has a milky-white appearance, coating removal is not yet complete, and it should be returned to the solvent. Occasionally, light brushing or wiping may be required to remove any last traces of coating.

To be certain that no residue remains from either the coating or the solvent, it is extremely important that the board be thoroughly washed in alcohol (isopropanol or methanol) immediately after coating removal is complete. The board may then be rinsed with deionised (DI) water and dried.

Because all of these solvents contain small amounts of ionic materials, it is advisable to test the rinse water for ionic contamination with a conductivity meter.

If you only need to remove a small area of the conformal coating to get at a few components or circuit traces, you can use a spot removal technique to remove polyurethane conformal coatings. In this case, you use a higher viscosity, or gel, form of the solvent, and apply it with a brush, cotton pad or cotton tipped swab. All of the solvents discussed here are available in gel form for spot removal.

The following table shows information for the chemical removal for polyurethane.

Polyurethane	Thickness	Solvent	Approx. Time for Removal
Conap CE-1155	.004	See Note 1	1.5 - 2.5 Hours
Conap CE-1155-35	.004	“	1.5 - 2.5 Hours
Conap CE-1164	.004	“	1.75 - 2.5 Hours
Conap CE-1165, 1166		“	*
Conap CE-1175	.004	“	1 - 2 Hours
Furane 5750-A/B(LV)		“	*
Furane 5750-A/B		“	*
Humiseal 1A20, 1A33, 1A34, 2A64		“	*
Hysol PC18M, PC29M		“	*
Products Research PR1568		“	*

* = No time study done

Note 1 - 2 types of chemicals recommended - Methanol Base/Acid Activator and Ethylene Glycol Ether Base/Alkaline activator.

Abrasive (Workstations)

The use of workstations for the spot removal of polyurethane is excellent. Because of its hardness, this technique of removal lends itself to this application. If a thickness of .004 is maintained, to remove the coating from an individual component will take less than 1

minute. If the thickness of the polyurethane any greater than .004 the only thin sacrificed is another minute or two.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Again, do use this technique, it's deadly	N/A
Mechanical	Depends on the thickness and skill of the operator	Don't even try.
Chemical	Care must be used. Masking may be required. Will still take about an hour	The best if removing coating from the entire board.
Abrasive	Fastest and easiest	Depends on the thickness of the coating.

Clean up

Thermal	N/A - Don't use this technique for polyurethane's.
Mechanical	If attempted, little clean up is required unless board is damaged.
Chemical	Messy, follow EPA regulations.
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

Silicone

Silicone conformal coatings offer high humidity, corrosion, and thermal resistance, which make them the preferred choice for high temperature applications.

Thermal

Silicones claim to fame is for high temperature applications. The soldering iron technique is also a high temperature application. Use caution and watch the fumes. Consult with the manufacturer before using this technique.

Mechanical

Because silicones are normally more elastic than other types of coatings, this technique can be used with some success. Just remember, cutting and scraping can damage the board.

Chemical

Over the past several years, chemical companies have developed solvents that are somewhat effective in removing silicone conformal coatings. Of these, the fastest and most popular is a methylene chloride based system. Several hydrocarbon-based solvents are alternatives to the methylene chloride based solvent. If dissolving just a small spot is a concern, you can use the slower but far more selective hydrocarbon-based solvents. These

slower solvents will not attack epoxy-glass PC boards, their components, metals or other plastics.

While not as fast as the methylene chloride, the hydrocarbon based solvents are more selective, and when not contaminated by water, will not attack epoxy-glass PCBs, their components, metals and most plastics.

As in the case of the polyurethane's, the coated board is immersed in the solvent at room temperature and allowed to stand until the silicone has dissolved or can be easily brushed off. The time required will vary with the solvent used, the type of silicone coating, the coating thickness, and the amount of surface area exposed. Typically, most coatings of 0.010 inch or less will be removed in 15 minutes to one hour. Certain chemically-resistant silicones may require extended immersion for several hours. The use of ultrasonics or agitation will reduce dissolving time.

After coating removal is complete, it is very important that the board be thoroughly washed in alcohol (isopropanol or methanol), then rinsed in DI water and dried. A saturated cloth or cotton-tipped swab may be used for spot removal. Repeated applications and brush may be necessary.

Some of the newer silicones will not come off with any form of chemical. Make sure you check with the manufacturer before you use any chemicals on newer silicones.

The following table shows information for the chemical removal for silicone.

Silicone	Thickness	Solvent	Approx. Time for Removal
Chemtronics Konform	.003	See Note 2	15 - 30 Minutes
Conap CE-1181	.006	"	15 - 30 Minutes
Dow Corning 3140/3145 RTV		"	*
Dow Corning 1-2577	.008	"	15 Minutes - 1 Hour
Dow Corning 1-2577 UVI		"	*
Dow Corning Hipec 3-6550	.005	"	15 - 45 Minutes
Dow Corning Hipec 648	.002	"	15 Minutes to 24 Hours
Dow Corning Hipec 01-4939	.005	"	15 Minutes
Dow Corning 01-2620		"	*
Dow Corning 01-2620 UVI		"	*
Dow Corning 03-6614		"	*
Dow Corning 03-6614 UVI		"	*
Dow Corning R4-3117		"	*
GE SR900	.004	"	30 Minutes
GE ECC 440, 450		"	*
W.R. Grace Amicon SC-120-4		"	*
WR Grace Amicon SC 3613		"	*
WR Grace Amicon SC-930		"	*

* = No time study done

Note 2 - 2 types of chemicals recommended - Methylene Chloride Base/Acid Activator and Hydrocarbon Base/Acid Activator.

Abrasive (Workstations)

Using conformal coating removal workstations to removing silicone up to .020 thickness is extremely easy, especially the newer silicones. Older silicones with a thick application can be time consuming because the media will bounce off the silicone.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Watch the fumes.	Don't even try.
Mechanical	Depends on the thickness and skill of the operator	Don't even try.
Chemical	Care must be used. Masking may be required. Will still take at least 15 minutes. Most feedback is negative.	Soak time must be watched or damage will occur. Fifteen minutes to overnight soak required.
Abrasive	Fastest and easiest in most cases, especially with newer silicones.	Depends on the thickness of the coating.

Clean up

Thermal	Messy.
Mechanical	Little if any.
Chemical	Messy, follow EPA regulations.
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

Acrylic

Acrylic conformal coatings have good humidity resistance, long pot life, and are relatively easy to apply. However, they have poor abrasion and chemical resistance.

Thermal

This seems to be the most popular way to get through acrylic conformal coating. Caution must me used when using any burn through technique however. Consult the manufacturer before you use this technique.

Mechanical

Acrylic is scraped off easily, if not applied too thick. Damage to the board is very possible.

Chemical

In the past, chemical removal of acrylic coatings was done with highly volatile or flammable solvents such as methylene chloride, trichloroethane, aromatics or ketones. Many

of these chemicals are no longer acceptable due to physical hazards, toxicity, or environmental regulations.

A relatively safe alternative based on butyrolactone has been developed for removal of acrylic conformal coatings. Most typical acrylic coatings will be removed within one hour after soaking in this solvent. After removal is complete, the PCB should be rinsed with alcohol or DI water, and then dried.

The following table shows information for the chemical removal for acrylics.

Acrylic	Thickness	Solvent	Approx. Time for Removal
Conap CE-1170	.007	Butyrolactone Base	1 Hour
Conap CE-1171	.007	"	1 Hour
Furane Acnlane 5730		"	*
Humiseal 1B31, 1B31-66, 1B31-FR		"	*
Humiseal 1B73		"	*
Hysol PC20M		"	*
Hysol PC20-35M		"	*

* = No time study done

Abrasive (Workstations)

Extremely easy to take off, even to strip off a whole board.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Quick and efficient, how safe it is depends on the operator.	Don't even try.
Mechanical	Quick and efficient. Care must be taken not to damage the board.	Don't even try.
Chemical	Care must be used. Masking may be required. Will still take at least one hour. Most feedback is negative.	Soak time must be watched or damage will occur.
Abrasive	Fastest and easiest.	Very fast compared to any other technique.

Clean up

Thermal	Little if any.
Mechanical	Little if any.

Chemical	Messy, follow EPA regulations.
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

Epoxy

Epoxy conformal coatings provide good humidity, chemical, and abrasive resistance.

Thermal

Use extreme caution when burning through epoxy. Though no known gas is emitted, check with the manufacturer before you use this technique.

Mechanical

Because epoxy is so hard, this technique is not recommended. Damage to the board most likely will occur.

Chemical

Complete coating removal for repair is nearly impossible by chemical means (except in the case of hermetically sealed hybrids), as the solvent can't discriminate between the epoxy coating, the epoxy-glass printed circuit board, and any epoxy-coated or potted components. However, if done carefully, spot removal of the coating may be accomplished by the application with a cotton-tipped swab of a solvent with a methylene chloride base and acid activator.

The following table shows information for the chemical removal for epoxies.

Epoxy	Thickness	Solvent	Approx. Time for Removal
All Types		Methylene Chloride Base/Acid Activator	For Spot Removal ONLY

Abrasive (Workstations)

The use of workstations for the spot removal of epoxy is excellent. Because of its hardness, this technique of removal lends itself to this application. If a thickness of .004 is maintained, to remove the coating from an individual component will take less than 1 minute.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Unknown, depends on thickness of coating.	Don’t even try.
Mechanical	Depends on the thickness and skill of the operator	Don’t even try.
Chemical	Don’t even try.	Don’t even try.
Abrasive	Fastest and easiest.	Labour intensive.

Clean up

Thermal	Little if any.
Mechanical	Little if any.
Chemical	N/A - Don't use chemicals with epoxy coatings.
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

Parylene

Paraxylylene conformal coating, or parylene, is applied by a vacuum deposition process. They offer excellent resistance to humidity, moisture, abrasion, high temperatures and chemicals.

Thermal
Can be done easily.

Mechanical
Care must be taken.

Chemical

The coated board should be immersed in a tetrahydrofuran base solvent for a period of two to four hours. This will cause the parylene coating to separate from the board. Rinse the board in alcohol and let dry; then physically remove the coating with tweezers.

The following table shows information for the chemical removal for parylene.

	Thickness	Solvent	Approx. Time for Removal
Parylene	.001	Tetrahydrofuran Base	2-4 Hours

Abrasive (Workstations)
Parylene is the easiest coating to remove by this technique. For spot removal, it is recommended that you mask the area you were to strip. This will give you a nice clean edge when you reapply the parylene.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Very good.	Don't even try.
Mechanical	Very good but care must be taken.	Don't even try.

Chemical	Don’t even try.	Don’t even try.
Abrasive	Fastest and easiest.	Fastest and easiest.

Clean up

Thermal	Little if any.
Mechanical	Little if any.
Chemical	Don’t use chemicals.
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

UV Cured Materials

The passage of strict environmental laws drastically reducing volatile organic compound (VOC) emission levels created a widespread need for a solvent less conformal coating. Consequently, the early 1980's saw the development of ultraviolet light (UV) curable conformal coatings as a way to eliminate air pollution, significantly reduce processing time, and reduce energy costs as compared to solvent-based, thermally cured coatings. These coatings were successfully developed by creating acrylated oligomers: epoxy acrylates, urethane acrylates, polyester acrylates, or combinations of several of them.

Thermal

Depends on the type of UV coating. Not recommended by manufacturers. Possible out gasses by most of these coatings.

Mechanical

Most UV coatings act like a cross between polyurethane and acrylic. Thickness of the application will determine if this technique should be used.

Chemical

Epoxy acrylates provide improved chemical resistance. Acrylated urethanes are flexible and tough. However, because of the "hybrid" chemical structure of these UV cured conformal coatings, chemical removal can be a little more complicated. While two different manufacturers' coatings may be of the same type of oligomer, for example acrylated urethanes, they may be different enough in composition that they require two completely different solvents to remove them. In some cases, a combination of two solvents used in succession may be required. With some conformal coatings, such as Loctite's Shadowcure 361, no solvent was found to be suitable.

Table 2 provides a guide for proper solvent selection for removal of UV cured conformal coatings. Generally, the removal process is the same as that for other coating types: the PCB should be immersed in the appropriate solvent; when coating removal is complete, the board should be thoroughly washed in alcohol, rinsed in DI water, and dried.

Removal times can vary anywhere from 15 minutes to 24 hours, depending upon the coating, coating thickness, and the solvent used. Agitation or the use of ultrasonics will speed up the procedure. Spot removal may be done by application of the solvent with a brush, cotton pad, or cotton-tipped swab. Some of the solvents may be available in a gel form for spot removal applications.

Table 2 - Solvent Selection Guide for Removal of UV-Cured Conformal Coatings

Conformal Coating Type	Thickness	Solvent	Approx. Time for Removal
Urethane acrylates			
Dow Corning X3-6765	.007	Methanol Base/ Acid Activator	4 Hours
Dymax Multi-Cure 984	.006	Dimethylformamide Base	15 Minutes
"	.006	Methylene Chloride Base/Acid Activator	15 Minutes
"	.006	Methanol Base/ Acid Activator	1 Hour
Dymax Multi Cure 984F	.006	Dimethylformamide Base	15 Minutes
"	.006	Methylene Chloride Base/Acid Activator	15 Minutes
"	.006	Methanol Base/ Acid Activator	1 Hour
Dymax Multi Cure 984RF	.006	Dimethylformamide Base	15 Minutes
"	.006	Methylene Chloride Base/Acid Activator	15 Minutes
"	.006	Methanol Base/ Acid Activator	1 Hour
Loctite Shadowcure 361	N/A	No Solvent was Found Suitable for Removal	N/A
W/R Grace Amicon UV-920	N/A	Methylene Chloride Base/Acid Activator	2.5 Hours
W/R Grace Amicon UV-920	N/A	Ethylene Glycol Ether Base/Alkaline Activator	24 Hours
Acrylated Epoxy Urethane			
DuPont Quickcure B-565	.003	Dimethylformamide Base	15 Minutes
"	.003	N-Methylpyrrolidone Base	1.5 Hours
"	.003	Methylene Chloride Base/Acid Activator	15 Minutes
"	.003	Butyrolactone Base	45 Minutes
DuPont Quickcure B-566	.003	Dimethylformamide Base	15 Minutes
"	.003	N-Methylpyrrolidone Base	1.5 Hours
"	.003	Methylene Chloride Base/Acid Activator	15 Minutes
"	.003	Butyrolactone Base	45 Minutes
Silicone			

Dow Corning X-4013	.011	Methylene Chloride Base/Acid Activator	15 Minutes
“	.011	Butyrolactone Base	45 Minutes
“	.011	Methanol Base/ Acid Activator	15 Minutes
“	.011	Ethylene Glycol Ether Base/Alkaline Activator	45 Minutes
Dow Corning X3-6760	.004	Methylene Chloride Base/Acid Activator	30 Minutes
“	.004	Ethylene Glycol Ether Base/Alkaline Activator	1.25 Hours
“	.004	Hydrocarbon Base/Acid Activator	1 Hour

Abrasive (Workstations)
Because most UV coatings act like a cross between acrylic and polyurethane, this technique of removal works extremely well.

Removal Time

Technique	Spot Removal	Whole Board
Thermal	Good.	Don’t even try.
Mechanical	Good but care must be taken.	Don’t even try.
Chemical	Care must be used. Masking may be required. Will still take between 15 minutes and 24 hours.	See above table. Caution must be used.
Abrasive	Fast.	Labour intensive, depending on thickness of coating.

Clean up

Thermal	Little if any.
Mechanical	Little if any.
Chemical	Messy, follow EPA regulations..
Abrasive	Depends on media type used. If plastic, no clean up, others will require further cleaning.

Bibliography

1. Conformal Coating Removal, Jay W. Parton, Electronic Servicing & Technology, July 1992
2. New Method of Stripping Conformal Coating, Vaughn Martin, Electronic Repair Basics, March 1995
3. Reprinted from “Fundamental Requirements For Static Protective Containers” by J.R. Huntsman, D.M. Yenni, Jr., and G.E. Mueller, Static Control Systems / 3M, St. Paul, Minnesota.

Summary by Technique

Removal Time - Thermal

Coating	Spot Removal	Whole Board
Polyurethane	Again, don't use this technique, it's deadly	N/A
Silicone	Watch the fumes	Don't even try
Acrylic	Quick and efficient, how safe it is depends on the operator	Don't even try
Epoxy	Unknown, depends on thickness of coating	Don't even try
Parylene	Very good, but be careful	Don't even try
UV Cured Materials	Good	Don't even try

Removal Time - Mechanical

Coating	Spot Removal	Whole Board
Polyurethane	Depends on the thickness and skill of the operator	Don't even try
Silicone	Depends on the thickness and skill of the operator	Don't even try
Acrylic	Quick and efficient. Care must be taken not to damage the board	Don't even try
Epoxy	Depends on the thickness and skill of the operator	Don't even try
Parylene	Very good but care must be taken	Don't even try
UV Cured Materials	Good but care must be taken	Don't even try

Removal Time - Chemical

Coating	Spot Removal	Whole Board
Polyurethane	Care must be used. Masking may be required. Will still take about an hour	The best if removing coating from the entire board
Silicone	Care must be used. Masking may be required. Most feedback is negative	Soak time must be watched or damage will occur. 15 minutes to overnight soak is required
Acrylic	Care must be used. Masking may be required. Will still take at least one hour. Most feedback is negative	Soak time must be watched or damage will occur
Epoxy	Don't even try	Don't even try
Parylene	Don't even try	Don't even try
UV Cured Materials	Care must be used. Masking may be required	Between 15 minutes and 24 hours

Removal Time - Abrasive

Coating	Spot Removal	Whole Board
Polyurethane	Fastest and easiest	Depends on the thickness of the coating.
Silicone	Fastest and easiest in most cases, especially with newer silicones.	Depends on the thickness of the coating
Acrylic	Fastest and easiest	Very fast
Epoxy	Fastest and easiest	Labor intensive
Parylene	Fastest and easiest	Fastest and easiest
UV Cured Materials	Fast	Labor intensive, depending on thickness of coating.

Clean up - Thermal

Coating	Clean Up
Polyurethane	N/A - Don't use this technique for polyurethane's.
Silicone	Messy
Acrylic	Little if any
Epoxy	Little if any
Parylene	Little if any
UV Cured Materials	Little if any

Clean up -Mechanical

Coating	Clean Up
Polyurethane	If attempted, little clean up is required unless board is damaged.
Silicone	Little if any
Acrylic	Little if any
Epoxy	Little if any
Parylene	Little if any
UV Cured Materials	Little if any

Clean up - Chemical

Coating	Clean Up
Polyurethane	Messy, follow EPA regulations.
Silicone	Messy, follow EPA regulations.
Acrylic	Messy, follow EPA regulations.
Epoxy	N/A - Don't use chemicals with epoxy coatings
Parylene	Don't use chemicals
UV Cured Materials	Messy, follow EPA regulations.

Clean up - Abrasive

Coating	Clean Up
Polyurethane	Depends on media type used. If plastic, no clean up, others will require further cleaning.
Silicone	Depends on media type used. If plastic, no clean up, others will require further cleaning.
Acrylic	Depends on media type used. If plastic, no clean up, others will require further cleaning.
Epoxy	Depends on media type used. If plastic, no clean up, others will require further cleaning.
Parylene	Depends on media type used. If plastic, no clean up, others will require further cleaning.
UV Cured Materials	Depends on media type used. If plastic, no clean up, others will require further cleaning.