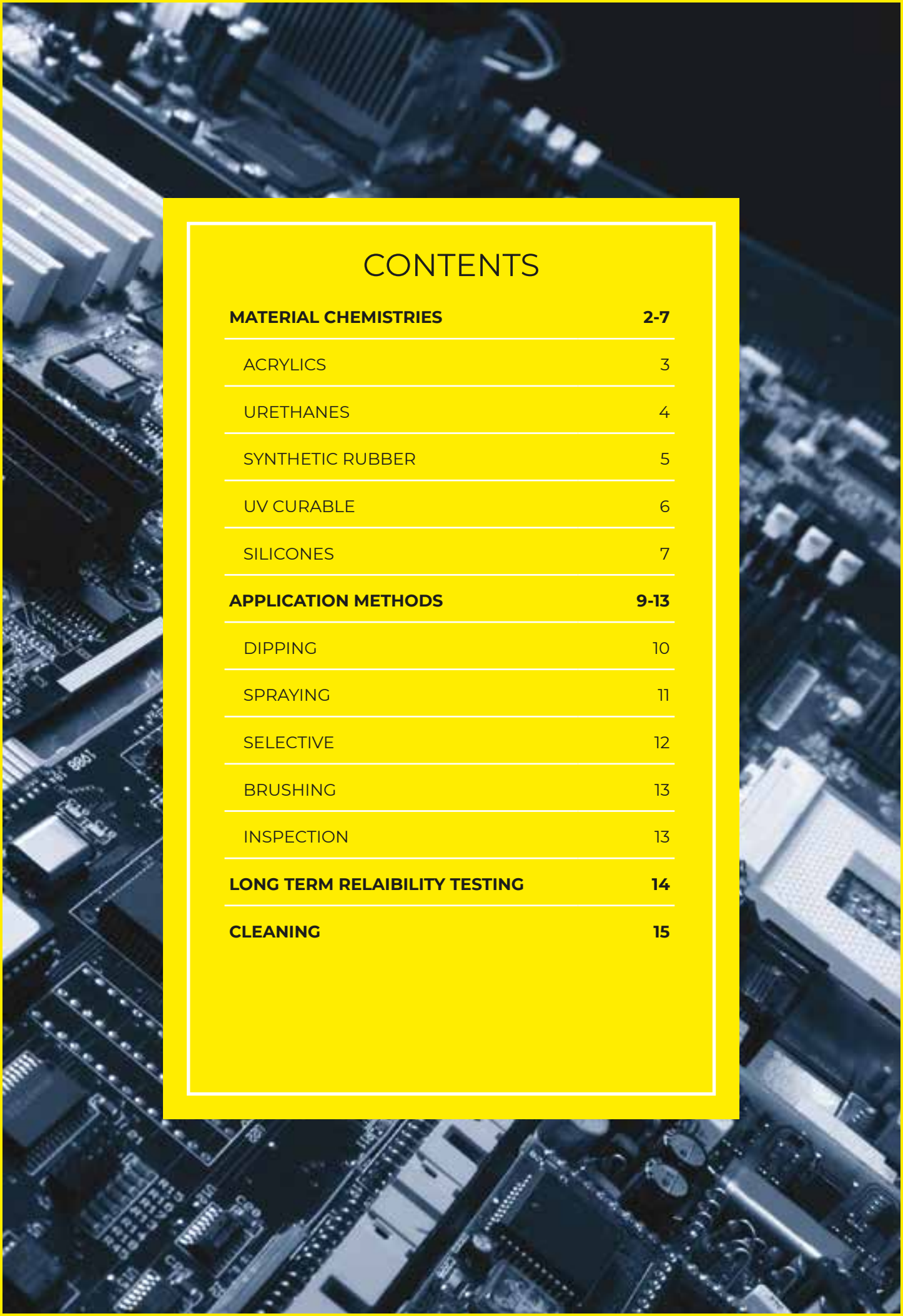
PRODUCTS, CHEMISTRIES & APPLICATION METHODS

HumiSeal®



CONTENTS

CONFORMAL COATINGS

The widest selection of electronic protective materials to meet our customer's tough electrical and environmental requirements.

A conformal coating is a thin polymeric film normally 25-200µm thick that conforms to the profile of the electronic assembly, protecting it from its operating environment.

> *The physical characteristics of any conformal coating must meet strict minimal standards.*

Electrically insulating with good dielectric properties, it ensures the operational integrity of the assembly. Its primary function is to protect PCAs used in hostile or harsh operating environments. This includes exposure to moisture, aggressive solvents, chemicals, gaseous environments, salt sprays, temperature variations, mechanical vibration, and organic attack (for example from fungus).

No conformal coating, however, can be regarded as a totally impermeable shield. Although many modern formulations are engineered to offer high levels of environmental protection, none can withstand total immersion in water or chemicals. They should instead be viewed as highly efficient and effective filters to harmful environmental effects at a molecular scale maintaining the integrity of the electronic circuit.

The physical characteristics of any conformal coating must meet strict minimal standards to provide this protection, HumiSeal have been producing conformal coatings for over 60 years and worked with organisations such as IEC, BSI & IPC producing standards for conformal coatings.

These currently include IEC 61086, IEC 60664-3, UL756E, UL94, IPC-CC-830 and MIL-I-46058C

The particular advantages of conformal coatings can be summarised as follows:

- Improves long term reliability.
- Insulating properties allow a reduction in PCB conductor spacing of over 80%
- Can help eliminate the need for complex, sophisticated enclosures.
- Light weight.
- Protecting the assembly against chemical and corrosive attack.
- Eliminate potential performance degradation/failure due to environmental hazards.
- Minimise environmental stress on a PCB assembly.
- Inherent flexibility protects over a wide temperature range.
- Reduces the effect of tin whiskers.

1 ACRYLICS

Provides good moisture resistance, easy to apply and remove for rework. Good dielectric properties.

2 URETHANES

Excellent chemical resistance combined with good moisture, temperature and dielectric properties.

3 SYNTHETIC RUBBER

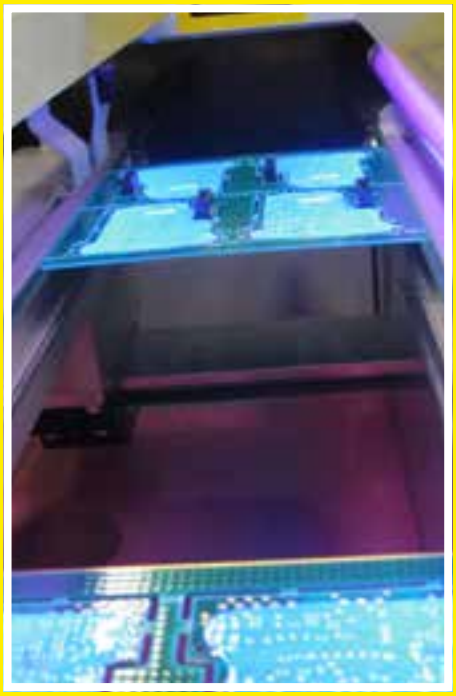
Excellent resistance to moisture permeability, good flexibility and wide operational temperature range.

4 UV CURABLE

Extremely fast cure speed, minimum VOC content, providing excellent moisture, dielectric and temperature resistance with high chemical resistance.

5 SILICONES

Hight temperature resistance and dielectric properties but limited moisture and chemical resistance.

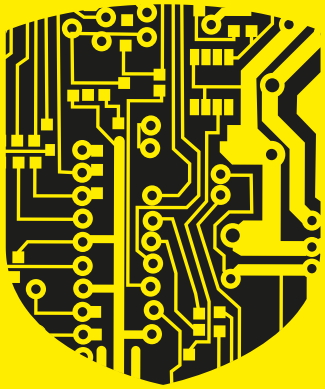


HumiSeal OnBoard

WHEN IT COMES TO PROTECTING ELECTRONIC ASSEMBLIES AND IMPROVING RELIABILITY, TRUST IS KEY.

ALL CHEMISTRIES

Each resin type exhibits different strengths and weaknesses and the eventual operating environment of the assembly determines the choice of material. When selecting a material work with the HumiSeal technical team to ensure correct selection and compatibility with your manufacturing process. HumiSeal works on the basis of continuous improvement and always has a material to protect against todays most stringent environments.



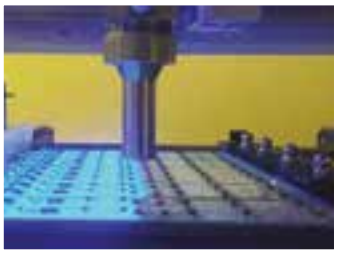
ACRYLICS

Acrylics dry to handling in minutes, can be applied by brush, dip, hand spray, automatic spray, and selective coating.

Cured in room temperature drying cabinets, at elevated temperatures or inline systems. Provides a high performance flexible coating complete with UV blacklight tracer for post application inspection.

Versions available approved to MIL-I-46058C for military use, automotive approval and general commercial use. Of the various types of conformal coatings available, acrylics offer high humidity resistance.

Are easy to apply and remove, have good dielectric properties, excellent clarity ideal for LED applications fair chemical resistance and good temperature resistance.



HumiSeal products enable customers to protect their electronic devices in a variety of operating environments. They are used in multiple industries to protect these devices while maintaining each customer's cost competitive advantages.

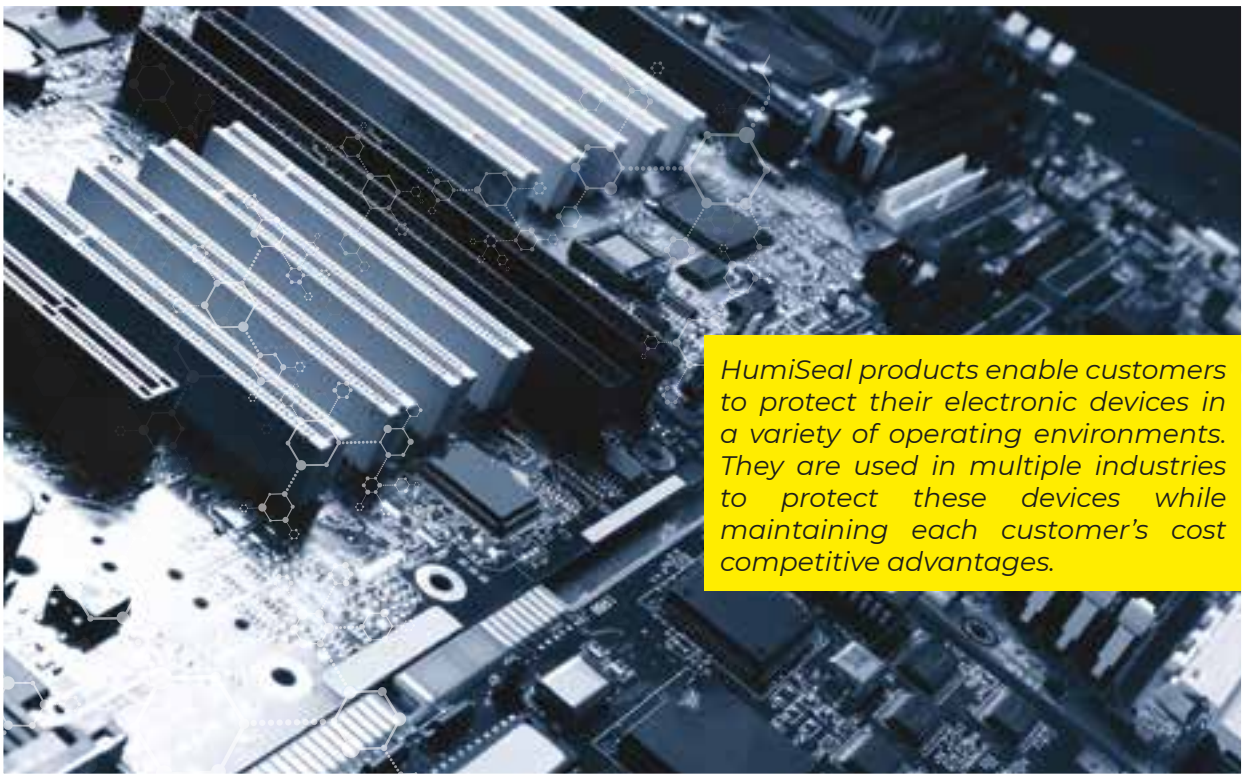
URETHANES

2

Polyurethane (commonly shortened to urethane) coatings offer excellent chemical resistance combined with good moisture, temperature and dielectric characteristics.

With a high level of chemical resistance they are ideal for harsher environments where a higher level of protection is required.

Due to the chemical resistance, specialist HumiSeal stripper compounds are required for removal, an alternative method is powder abrasion, please talk to the HumiSeal tech support team for the best solution. Urethanes are available as either single or two-component formulations.



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SYNTHETIC RUBBER

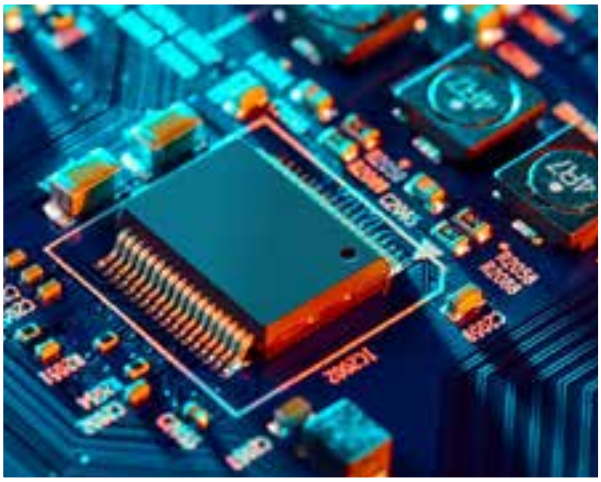
3

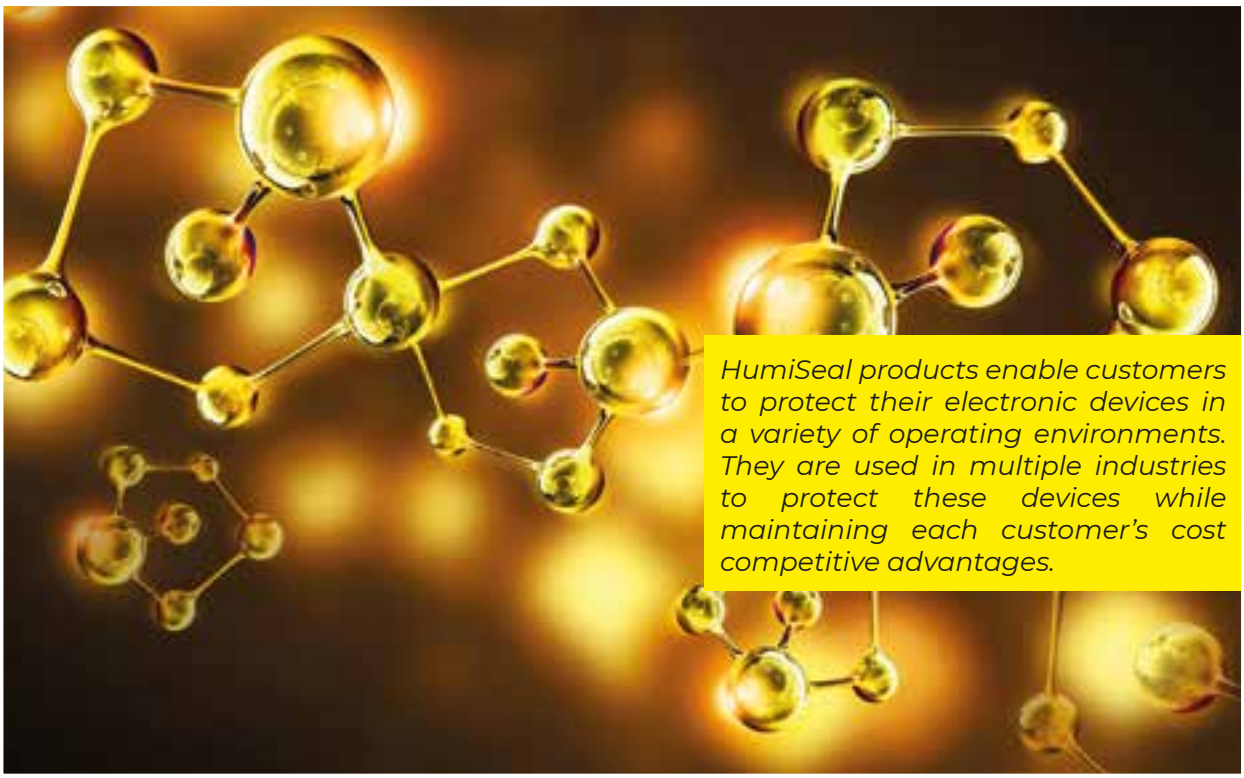
HumiSeal's synthetic rubber coatings have been developed in response to the ever-demanding performance requirements of automotive electronics with wider operating temperatures.

The synthetic rubber range is also relevant to todays higher component packing densities and fine line technology with every decreasing track spacing, where a higher operating temperature is required combined with grater coating flexibility.

The technology boasts excellent moisture protection, with the lowest moisture permeability of all the resins used for conformal coatings.

Operating over a wide temperature range, -65'C to +150'C it can be applied by brush, dip, hand spray, automatic spray, and selective coating methods are fast drying either at room temperature or at elevated temperatures.





HumiSeal products enable customers to protect their electronic devices in a variety of operating environments. They are used in multiple industries to protect these devices while maintaining each customer's cost competitive advantages.

UV CURABLE

4

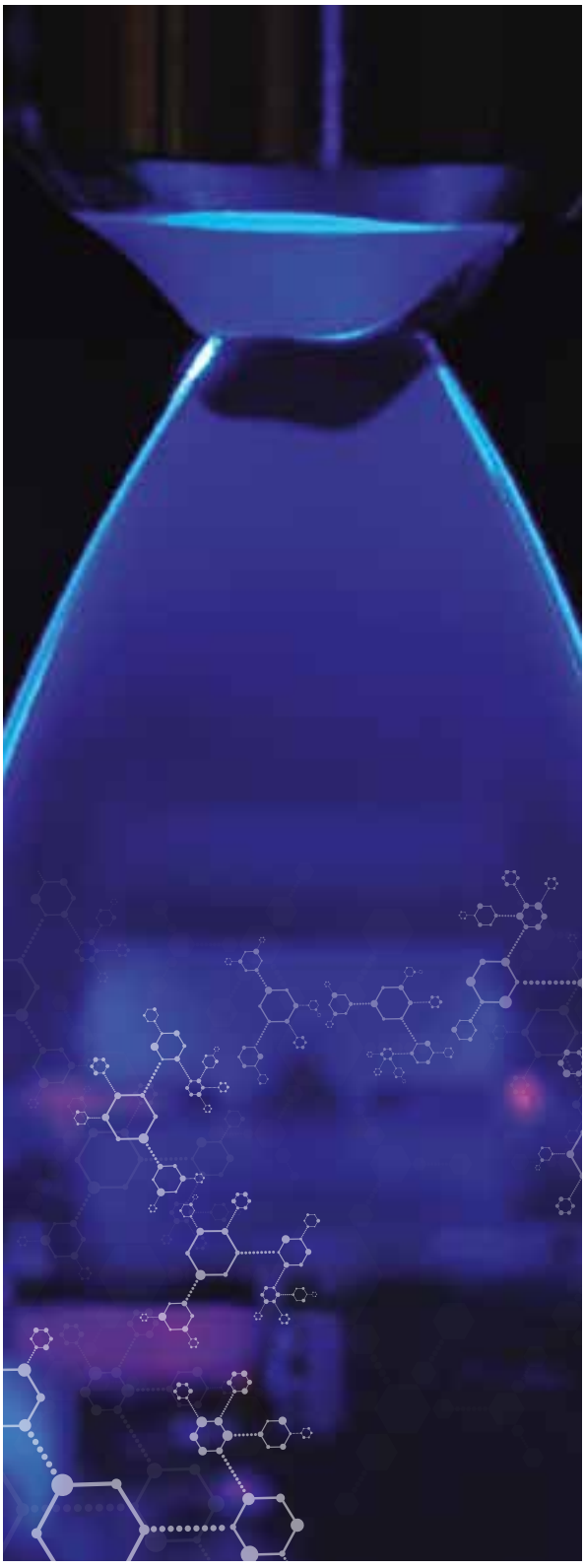
HumiSeal Ultraviolet (UV) light curable conformal coatings offer extremely fast cure speed and minimum VOC content as well as providing excellent moisture, dielectric and temperature resistance with high chemical resistance.

Due to the chemical resistance, removal is best achieved with powder abrasion, please talk to the HumiSeal tech support team for further information.

UV curable materials are especially suited to high volume, selective coating applications and due to the extremely low footprint of the curing equipment can free up valuable floor space.

All HumiSeal UV cure materials have a secondary cure mechanism to ensure full cure in shadowed areas and under components.

The latest additions to the range have higher flexibility and therefore perform well under thermal shock conditions.



Due to their extremely good chemical resistance, most UV curable materials are difficult to rework, although modern formulations can be successfully removed with powder abrasion methods.

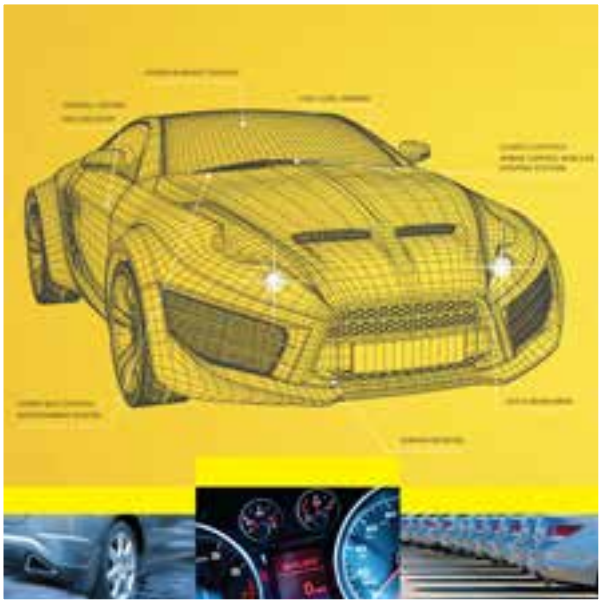
SILICONES

5

Silicone coatings offer high temperature, resistance up to 200°C with good dielectric properties.

Of all the resins used for conformal coatings silicones have the highest moisture permeability and therefore provide the least moisture resistance, and should only be considered for high temperature low moisture conditions.

The coatings can be applied by brush, dip, hand spray, automatic spray, and selective coating methods, for use at elevated temperatures the products must be heat cured.



HumiSeal®

SUPPORTING CONFORMAL COATING

Training modules that cover everything that you need to implement a successful **conformal coating** process.

A LIFETIME OF EXPERIENCE SUPPORTING & TRAINING CUSTOMERS

Definition & *Chemistries*

Covers the basics of what conformal coatings are, what they do as well as looking at the availble chemistry types.

Application *Methods*

What is the best way to apply for your application and what considerations should be made?

Coatings *Selection*

Make the right choice in coatings material selection with greater understanding of material strengths, board design, and required standards/specifications.

COATINGS ACADEMY

Learn from the coating experts with on-site or HumiSeal based training via the Coatings Academy.

Learn the strengths and weakness of the various coating chemistries, applications methods as well as industry standards plus much more.

Coatings Academy®

Talk to us today

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HumiSeal®

APPLICATION

To be effective, a conformal coating should be correctly applied so that it covers all critical areas of the assembly and provide good coverage of components and component leads.

When selecting a conformal coating for a project not only must you consider the environment that the coating has to protect against but also the application method.

The effectiveness of the coating is to some degree influenced by the efficiency of the application method, which also governs the type of coating used, HumiSeal offers dedicated versions of their conformal coatings to suit different application methods.

There are essentially four ways of applying a conformal coating that have developed over the years : Brush, Dip, Spray and selective robotic coating. We review each method below.

1 DIPPING

Automated dip coating of printed circuit assembles provides total coverage around and under components but requires that the board is designed for this method and has secure masking for components not required to be coated. Systems can be stand alone or inline with integral curing.

2 SPRAYING

Spraying can be either hand spray using a conventional hand spray booth or inline automatic spraying equipment that puts down multiple coats as the PCA passes through the system. Hand spraying is useful for small to medium production runs, inline automatic systems for medium to high volume. Masking is still required but not as secure as for dip coating.

3 SELECTIVE

The most popular contemporary method of application is selective robotic coating. This exploits high precision automated equipment to selectively apply a conformal coating thereby eliminating the need for masking prior to coating the assemblies. Systems can be standalone or inline with curing ovens.

4 BRUSHING

Brushing can be used for prototype boards and to coat small quantities of printed circuit assemblies.
Appling a conformal coating by brush requires extremely proficient and skilled operators in order to obtain uniform coverage whilst controlling bubble formation, it is neither a practical nor efficient method for mass production.

DIPPING

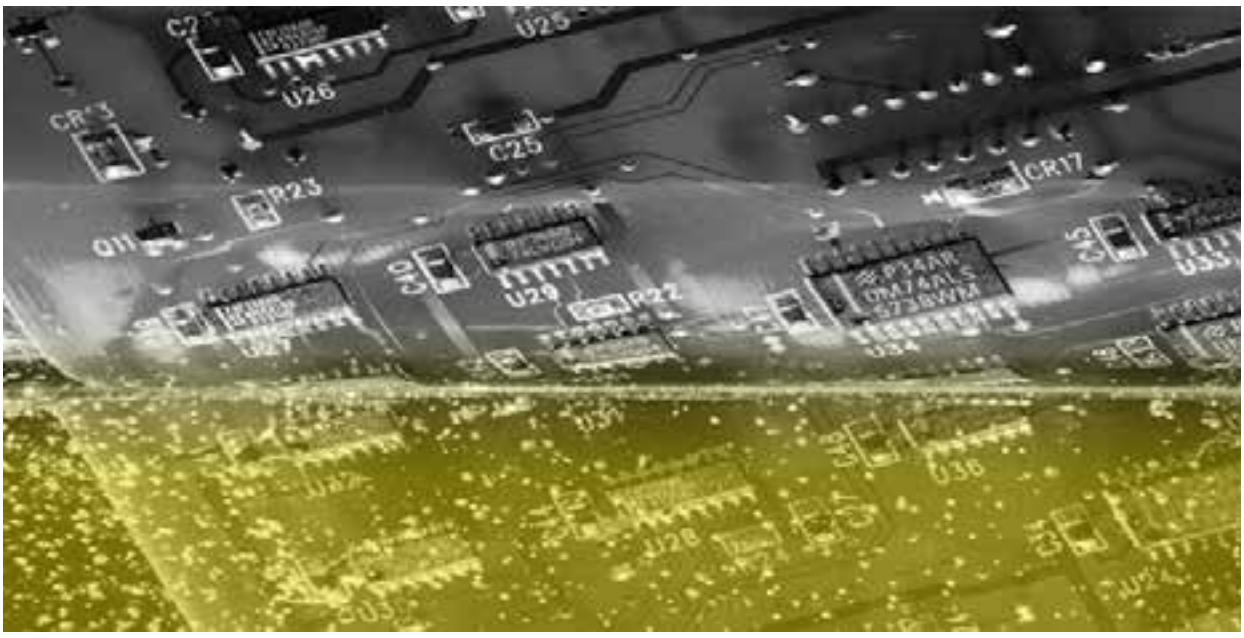
The most important factor influencing the results of dip coating is the speed of the assembly's immersion (insertion into the tank) and withdrawal. Typical recommended immersion speeds are between 100mm to 150mm / minute to allow sufficient time for the coating to displace the air surrounding components and to avoid air bubble entrapment.

If the boards have areas that still entrap air, then a dip dwell should be used to allow trapped air to percolate out.
To achieve uniform coating the withdrawal speed must be slower than the cascade effect of the coating material, normally 50mm to 150mm /minute depending on the components and board profile, allowing a homogenous film to form on the entire assembly. The rate of withdrawal has to be balanced with the coating thickness and aesthetic finish required.

Dipping promotes full and simultaneous penetration under and around components on both sides of the assembly, any components not required to be coated will need masking, this is normally done with masking tape designed for conformal coating or preformed masking boots.

Assemblies would normally be dipped vertically, but where designs do not lend themselves to vertical dipping, horizontal dipping can also be used.

A range of dedicated, automated machinery is available for this purpose, which at the top end typically achieve throughput rates of between 350 to 700 boards per hour.



SPRAYING

2

Spray coating can be subdivided into two alternative methods:
Hand Spraying using either aerosols or a dedicated spray booth, automated spray application either stand alone or inline. Masking will still be required for those areas not requiring coating.

For hand spraying with either aerosols or a hand spray gun, use the following technique to ensure full coverage of shadowed areas and to build thickness without entrapped bubbles.

The PCA should be placed on a rotating table in an extracted booth, the coating should be applied in left to right passes about 150mm from the board surface at a 45’ angle moving forward, when the complete board has be covered turn the board through 90’ and repeat the process, this should be done four times, this is the first coat done, the board should now be put in a drying cabinet until touch dry, when touch dry repeat the above process. This process should be done three to four times for each side of the board depending on the conformal coating type and the coating thickness required.

As can be seen from the above, hand spraying is a lengthy process but is ideal for low volume production where dipping is not practical.

For high volume spray application inline automated systems are available complete with inline flash off and curing.

SELECTIVE

3

The most popular contemporary method of conformal coating application is via selective robotic coating. This exploits high precision automated machinery to selectively apply a coating to assemblies, which are either loaded manually or fed into the machine via dedicated conveyors for in-line processing.

The benefits of selective robotic coating machines are that they provide consistent, automated application of coating material, eliminates the need for masking and have a high throughput.

In addition, if a PCB is designed to be coated via a selective robotic coating machine (components that are not to be coated are kept well away from those that are) the need for custom tooling and/or board masking is minimised.

Selective spraying does not, however, eliminate the need for masking but does help minimise it. (Note: vias on double sided boards, for instance, may lead to coating of underside components that need to be protected and therefore must be masked prior to spraying.)

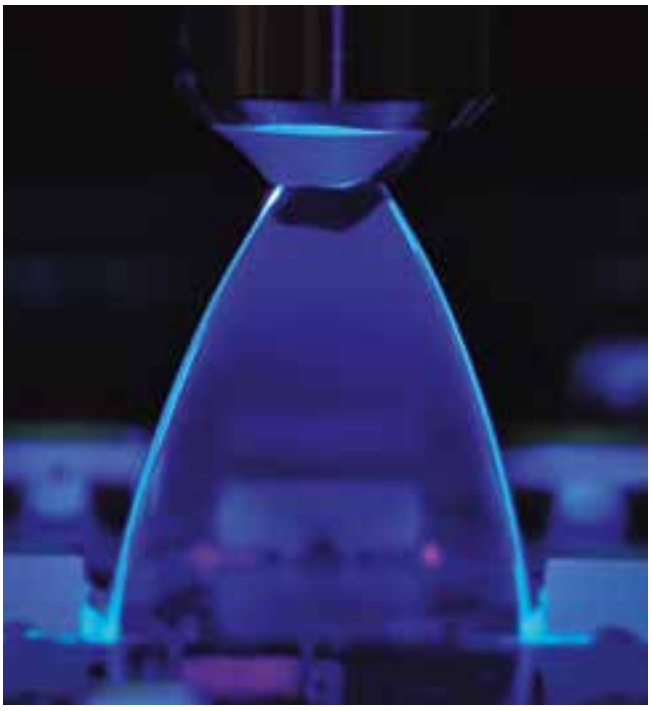
Most selective robotic coating machines use a combination of dispense needle/nozzle to deposit a bead or film of coating in and around components and PCB features and/or an airless-dispensing technology or air-spray to 'fill-in' larger areas. These are mounted on a robot programmed to move and dispense material in designated locations on the assembly.

Coating deposition can be classified as either atomised (breaking the coating material into fine particles during application), non-atomised (dispensing the coating in liquid form) or film coating creating a narrow leaf shaped film approximately 10mm wide.

Atomised spray dispensing replicates hand spray in a controlled manner where the atomized spray can be turned on and off to give selective coating of a PCA.

In needle dispensing (non-atomised), the coating material is dispensed as a bead, and is normally used to apply high viscosity gel material for sealing around connectors or for dam and fill.

Film coating produces good edge definition enabling accurate selective coating application, can be used with both solvent based material and 100% solids material. Systems can be free standing or inline with curing systems.



BRUSHING

4

Brushing can be used to coat small quantities of printed circuit assemblies for prototyping or very low production volumes.

To apply a conformal coating by brush, it is best to use the product at full viscosity, in an inspection booth with long wave black light, using the materials florescent tracer to assist in producing an even film. When applying a solvent based material have a container of compatible solvent next to the container of conformal coating, first dip the brush in the solvent and then in the coating, when applying the coating allow it to flow onto the surface, do not paint in on. Always check the thickness of the dried film, remember thicker is not better when applying a conformal coating.

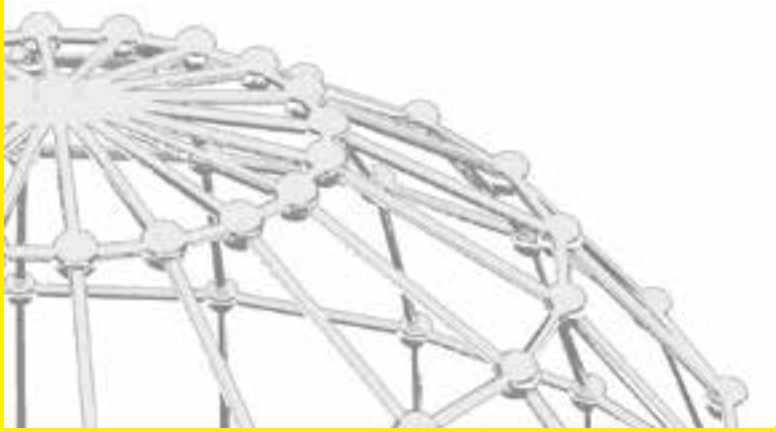
INSPECTION

Inspection of the PCA after application of a conformal coating is the final stage of the process but very important for the long term reliability of the PCA.

Conformal coatings contain a UV trace that glows with a bright blue luminescence under long wave UV light to make coated and uncoated areas easily detectable. With experience, operators can use the degree of luminescence as a measure of both presence and volume of coating at different locations across a board's surface.

The necessity for inspection becomes evident when one realizes that voids or bubbles can potentially provide a path for moisture to penetrate to the substrate. With automatic coating, a random or pre-selected interval test may be adequate, but 100% inspection is always recommended, and is mandatory in high reliability and safety critical applications. There is a range of dedicated products available for this purpose.

It is also important to inspect boards after rework to ensure any re-application of coating material doesn't end up on the inside or underside of devices that should not be coated such as connectors.



LONG TERM RELAIBILITY TESTING

Conformal coatings are not water barriers, they are intended for high humidity environments acting as a barrier to airborne contaminates, in fact conformal coatings 'breathe' in the sense that moisture permeates in and out of the coating, that is why you will see both, insulation resistance, normally taken at room temperature / humidity and moisture resistance, taken at 85'C / 85% humidity in a test chamber on our data sheets.

It should also be remembered that conformal coatings will seal in contaminants left on the PCA before coating, these can have various effects on the finished coating and long term reliability.

Contamination comes from many sources, unactivated flux residues, possibly trapped under vitrified flux, finger salts from handling with ungloved hands and even plating/etch salts from bare board production.
When moisture finds ionic contamination, that is hydrophilic i.e it is soluble in water, it will form a conductive solution and if between negative and positive tracks it acts as a plating cell and a dendrite will start to grow from the positive track to the negative track lowering the surface insulation resistance and causing either intermittent faults or total failure.

What is the definition of a dendrite, it is a crystalline mass with a branching structure made up of metallic salts, therefore is conductive, hence the lowering of surface insulating resistance.

That is why it is always wise to check compatibility of your selected solder paste/flux and your manufacturing process with the selected conformal coating.

The first stage is to assess the level of PCA cleanness at the end of the process using ionic extraction testing looking for a level down to at least 0.5µ gms/cm2 NaCl before applying the conformal coating.

To really access the long term reliability of the product and check overall compatibility of your components, process and conformal coating, you should run SIR testing at 85/85 for 7 days using a
a loaded test board run on your process line using your materials.

CLEANING

To clean or not to clean that is the question. In the days before no-clean, manufactures who wanted reliability in their product would clean and if high reliability was required would conformaly coat after cleaning.

With the introduction of no-clean solder paste & Flux manufactures were convinced that they no longer had to clean to achieve reliability.

In the 1980's and 1990's automotive manufactures used process validation to prove to themselves that no clean worked.

This was OK with track width / spacing and packing density's of that period, but with todays fine line technology and leadfree solder, cleaning is becoming popular again.

The ultimate objective of cleaning is to produce a completely clean assembly, free of contaminants to ensure long term reliability.

There are two types of contamination that need to be removed.

- **Hydrophobic** : Water hating, non-polar, oils & fats that can cause problems with the application of conformal coating.
- **Hydrophilic** : Water loving, polar, salts that can cause Dendritic growth and ultimately PCA failure.

There are basically three methods of cleaning PCA's to remove both polar and non polar contaminates.

Water based, consisting of a wash process using surfactant cleaners, with no flash point and very low VOC content followed by DI water rinse stages.

Semi aqueous, normally using ultrasonic or spray under immersion with a solvent based cleaning agent followed by several DI water rinse stages.

Water free, using broad spectrum solvent based cleaners that cover both polar and non polar contaminants, with a ultrasonic or spray under immersion wash stage followed by rinse stages using fresh solvent.

Used for cleaning lead-free as well as leaded assemblies, various cleaning machines and process types are available. It is important to note that a thorough drying cycle of the PCA must be undertaken prior to the application of conformal coating. If the cleaned assemblies are not to be coated immediately, they should be stored in a desiccation cabinet or a sealed non-contaminating antistatic bag.

A GLOBAL SOLUTION

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