Clean, Protect, Lubricate

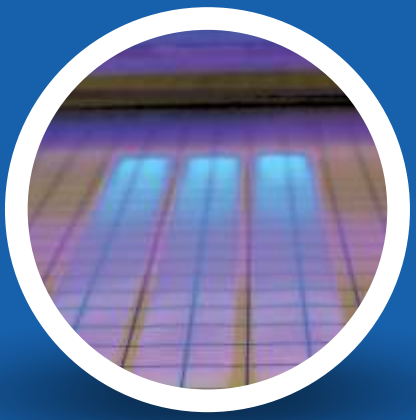
ELECTROLUBE

Conformal Coatings

www.electrolube.com

Conformal Coatings

- UL, MIL and IPC-CC-830 approved
- Solvent removable and solvent resistant coatings
- Acrylic, Silicone, Polyurethane and Solvent Free
- Non VOC
- UV trace to aid inspection
- Thinners and masking products



Conformal coatings are designed to protect printed circuit boards and related equipment from their environment.

Typically applied at 25-50µm, these coatings 'conform' to the contours of the board allowing for excellent protection and coverage, ultimately extending the working life of the PCB. The use of conformal coatings is important in automotive under-bonnet applications, particularly in safety critical areas, such as military, aerospace and industrial applications.

Electrolube is among the world's foremost experts in the formulation and application of conformal coatings designed to meet international approvals (including European and American military specifications). The range of products currently available comprises acrylics, silicones, polyurethanes, water-based and non-VOC coatings.

Electrolube can offer both transparent and pigmented coatings to improve or camouflage the appearance of printed circuit boards. The range also includes a number of ancillary products to complement the use of our conformal coatings. These include thinners and removers, peelable coating masks and thixotropic materials for the effective coating of lead ends.

Conformal coatings can be used in a wide range of environments to protect circuitry from hazards such as moisture, salt spray, chemicals (e.g. fuels, coolants, etc.) and high temperature. This can prevent corrosion, mould growth and electrical failures such as current leakage. The protection provided by conformal coatings allows for higher power and closer track spacing, in turn enabling designers to meet the demands of miniaturisation and reliability.

Application of Conformal Coatings

In order to achieve the best performance, it is imperative that the most suitable coating and method of application is chosen.

The main questions which need to be addressed during this selection period are;

Application Method

Conformal coatings can be applied via spray, dip or brush methods either by manual or automated application. The correct method and conditions should be assessed for each application. Careful consideration of the advised humidity and temperature conditions for the selected coating should be taken for both application and curing stages.

Working Environment

The coating must be suitable for use under the required operating conditions. Tests must take place to ensure that the coating retains all required properties throughout the duration of the required use.

Electrical Requirements

Conformal coatings form a protective, insulating layer. The coating should exhibit high dielectric strength; the minimum required can be determined from the inter-track separation and the potential difference between adjacent tracks.

Board Layout

The design of the board should include consideration of the placement of components that should not be coated. Selective spray equipment or the application of a peelable coating mask can be used to help avoid the coating of such components.

Rework and Repair

If the assembly requires repair then consideration must be given to the ease of removal of the coating.

Electrolube offer a range of solvent-based and solvent-alternative conformal coatings.

The most widely used materials are historically solvent-based, the benefits of which include:

- Ease of processing and application
- Simple viscosity adjustment
- Suitability for a range of application methods
- Tailored application and cure

VOCs – The Need For Change

- Volatile solvents used in conformal coatings are classed as VOCs (Volatile Organic Compounds).
- VOCs contribute towards the formation of ground level ozone.
- Such pollution can have many detrimental effects on the environment, damaging forests and vegetation.
- In addition, some materials classed as VOCs can act as irritants and over exposure can lead to a variety of health problems.

VOC Definitions

EU Solvents Emissions Directive – "Any organic compound having at 20°C a vapour pressure of 0.01kPa or more, or having corresponding volatility under the particular conditions of use".

EPA – "Volatile Organic Compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate, which participates in atmospheric photochemical reactions".

Electrolube offer alternatives to solvent-based coatings:

WBP and WBPs are water-based coatings. WBP is designed for dipping applications whereas WBPs is designed for selective spray.

NVOC is a non-VOC coating based on polyurethane pre-polymer technology. It has been uniquely formulated to provide a ready to use, low viscosity system for selective spraying, therefore making it suitable as a replacement for solvent-based materials in many applications.

Investigation & Methodology

A coating needs to be exposed to a range of environments / test schedules to establish the performance range and limitations.

The ideal coating:

- Good electrical properties,
- Low moisture permeability,
- Good physical characteristics,
- Excellent adhesion to all board materials.

Basic tests:

- Electrical performance and accelerated humidity testing.

Advanced testing:

- Severe conditions such as salt mist, temperature extremes or rapid environmental changes.

Approvals

The following Electrolube conformal coatings are approved to the standards listed:

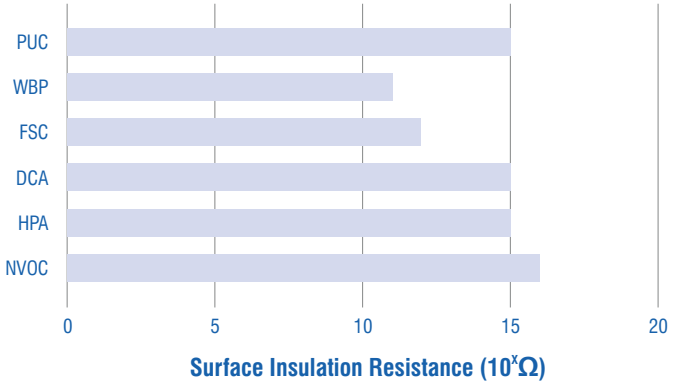
- DCA (SCC3) – UL746, Def Stan 59/47
- TFA – IPC-CC-830
- HPA – MIL-I-46058C
- FSC – IEC 61086

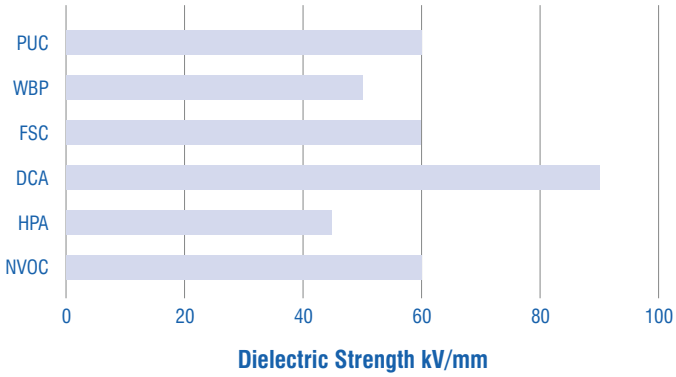
Many other coatings also meet the requirements of these standards.

Electrical Testing

Evaluation of electrical properties is essential in all conformal coating applications. Some typical tests and standard methods include:

Dielectric Strength	**ASTM D149**
Dielectric Constant (100Hz)	**ASTM D150**
Dielectric Factor (100Hz)	**ASTM D150**
Surface Resistivity	**ASTM D257**
Comparative Tracking Index (CTI)	**BS EN 60112:2003**



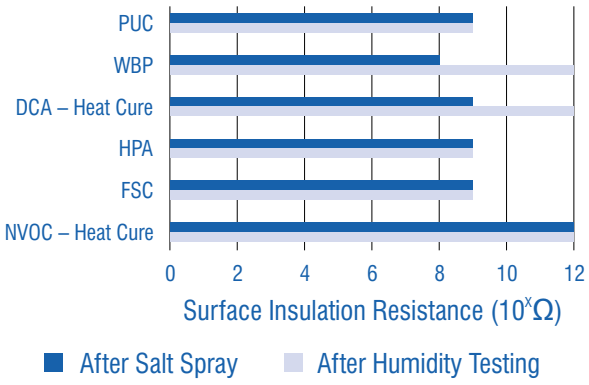


Coating Chemistries

Acrylic	**HPA, APL,TFA**
Silicone Acrylic	**FSC**
Modified Silicone	**DCA (SCC3)**
Polyurethane	**PUC**
Water Based PU	**WBP**
Non-VOC	**NVOC**

Environmental Testing

- Environmental testing is essential to ensure the required level of protection.
- Conditions are replicated or accelerated.
- Elevated levels of humidity, salt mist and temperature cycling or extremes.
- These parameters are either tested individually or combined, depending on the requirements.



Environmental Cycling

Based on UL746 test methods, the following environmental cycling profile can be utilised:

- 24 hours immersed in water, followed by
- 24 hours at 105°C, followed by
- 96 hours at 90% RH, 35°C, followed by
- 8 hours at -70°C – end of cycle
- 3 cycles

DCA (SCC3) is approved to UL746.

Humidity Tests

Humidity tests were carried out on coated comb pattern boards, similar to those in IPC-TM 650 2.6.3.4

- 85-90% RH, 40°C, 50V DC, 168 hours

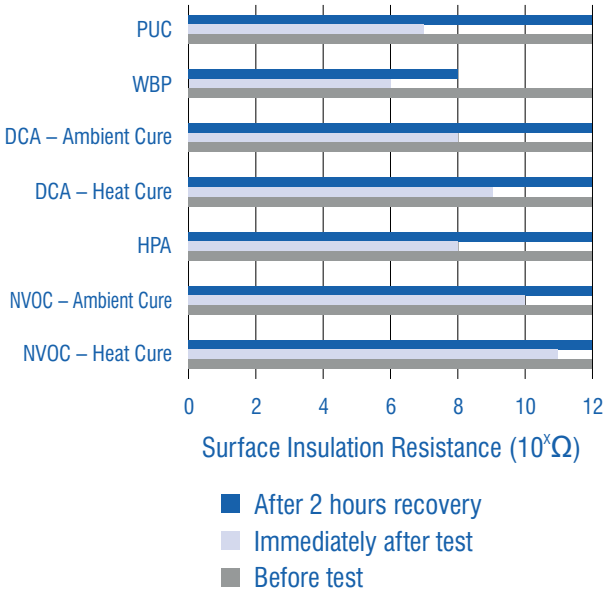
Salt Mist Tests

Salt mist tests were carried out according to IEC 60068-2-11

- 5% salt solution
- 35°C, 168 hours

Water Immersion

- Immersion in water is an extremely harsh test for a conformal coating to pass.
- Most coatings will resist immersion for short periods of time however prolonged testing can highlight issues.
- Coated boards were immersed for 7 days and the SIR results compared.



Solvent Resistance

Solvent resistance tests can be carried out in accordance with IEC 61086-2. The performance of the coating will largely depend on the solvents used during the test. Those marked excellent will have a very high level of solvent resistance. Those marked good have a reasonable solvent resistance but may be reworked with some solvent-based materials.

PUC	**Excellent**
WBP	**Excellent**
FSC	**Good**
DCA – Ambient Cure	**Good**
DCA – Heat Cure	**Excellent**
HPA	**Good**
NVOC – Ambient Cure	**Excellent**
NVOC – Heat Cure	**Excellent**

Flame Retardance

Flame retardance of the coatings were tested to UL94.

- DCA, HPA, APL, WBP/s and TFA meet the requirements of UL94 V-1 grade
- NVOC meets the requirements of UL94 V-0 grade
- PUC meets the requirements of UL94 HB grade

Thermal Cycling

A thermal cycling profile was set up as per IEC 60068-2-14

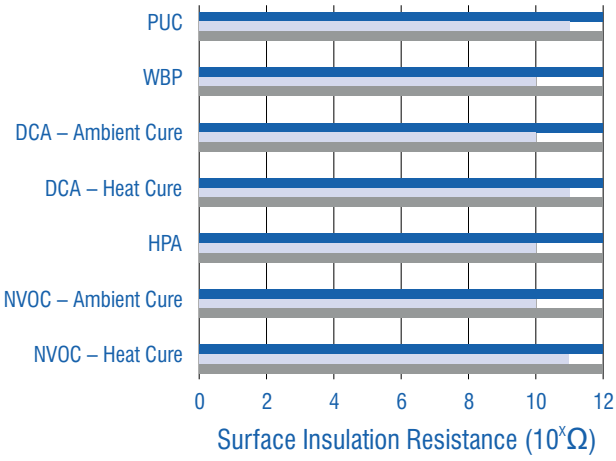
- -55°C to +125°C, 25 minutes at each temperature
- 12°C/min rate of temperature change
- 20 cycles

Coated tin, copper, aluminium and FR4 panels were subjected to the cycling and then tested for adhesion (BS EN ISO 2409) and flexibility (3mm mandrel — IPC-TM 650 2.4.5.1)

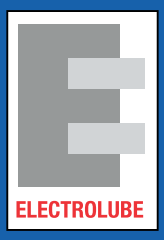
All Electrolube conformal coatings pass this test when applied to the substrates described above.

Corrosive Gas Testing

- Corrosive gas testing involves exposing PCBs to a mixed gas environment containing hydrogen sulphide and sulphur dioxide — BS EN 60068-2-60 , method 1.



Should you require any further information, please visit **www.electrolube.com** or, contact the Electrolube Technical Department on **Tel: +44 (0) 844 375 9700**.



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