

## Manufacturing Process - How long does it take to coat a PCB?

Cost of the manufacturing is affected by the time taken for processes, the equipment requirements and the levels of energy and resource required to coat PCBs. 3M Novec Surface Modifiers demonstrate clear time benefits in the coating manufacturing cycle. Energy and resource requirements are lower and the excellent health and safety profile reduces equipment coating suppliers must use – this

can contribute to a reduced total cost of coating and the overall cost of electronics manufacturing

It is advised that to maximise lifespan and effectiveness the PCB is cleaned before a coating is applied. 3M also offer a range of Novec Cleaning solvents for circuit boards. Visit [www.3M.co.uk/NovecCleaning](http://www.3M.co.uk/NovecCleaning) for more details.

Processes (Roll over for explanation)	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
Masking	0	0	30 Minutes	30 Minutes	30 Minutes	30 Minutes	30 Minutes
Loading	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute
Coating	1 Minute	1 Minute	20 Minutes	20 Minutes	20 Minutes	20 Minutes	20 Minutes
Drying	6 Minutes	6 Minutes	30 Hours	24 Hours	4 Hours	30 Hours	30 Minutes
De-Masking	0	0	10 Minutes	10 Minutes	10 Minutes	10 Minutes	10 Minutes
Curing	30 Minutes	0	30 Minutes	1 Week	4 Hours	30 Hours	10 Minutes
Inspection	0	0	Up to 1 Hour	Up to 1 Hour	Up to 1 Hour	Up to 1 Hour	Up to 1 Hour
<b>Total Process Time</b>	<b>Under 40 Minutes</b>	<b>8 Minutes</b>	<b>Up to 3 Hours</b>	<b>Over 1 Week</b>	<b>Up to 10 Hours</b>	<b>Up to 60 Hours</b>	<b>Up to 3 Hours</b>

## Ask Mark!

Mark Nursall is the technical sales specialist for 3M Electronics Materials Markets Division. Mark has a long background in the chemicals industry and is our leading expert in the field of electronic coatings.

We understand that in choosing the right coating solution you require support to ensure you are using the best possible solution which meets your needs. To help answer any of your coating questions we have created a forum on our Novec Coating website where Mark will be able to support you directly.



Printed circuit board coated with 3M Novec Surface Modifier

## Assistance from product to process

At 3M, we provide our customers with extensive product and process support that begins even before you become a customer. 3M products are supported by global technical and customer service resources. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

If you require further information, then come visit our website [www.3M.co.uk/noveccoating](http://www.3M.co.uk/noveccoating)

Alternatively you can email us at [3Melectrouk@mmm.com](mailto:3Melectrouk@mmm.com) or call **0870 609 4639** and speak to one of the team.

## The 3M™ Novec™ Brand Family

- 3M Novec Engineered Fluids
- 3M Novec Aerosol Cleaners
- 3M Novec Fire Protection Fluid
- 3M Novec Electronic Coatings
- 3M Novec Electronic Surfactants

The Novec brand is the hallmark for a variety of patented 3M products. Although each has its own unique formula and performance properties, all Novec products are designed to address customer needs for safe, effective, sustainable solutions in a number of industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, lubricant deposition and several specialty chemical applications.

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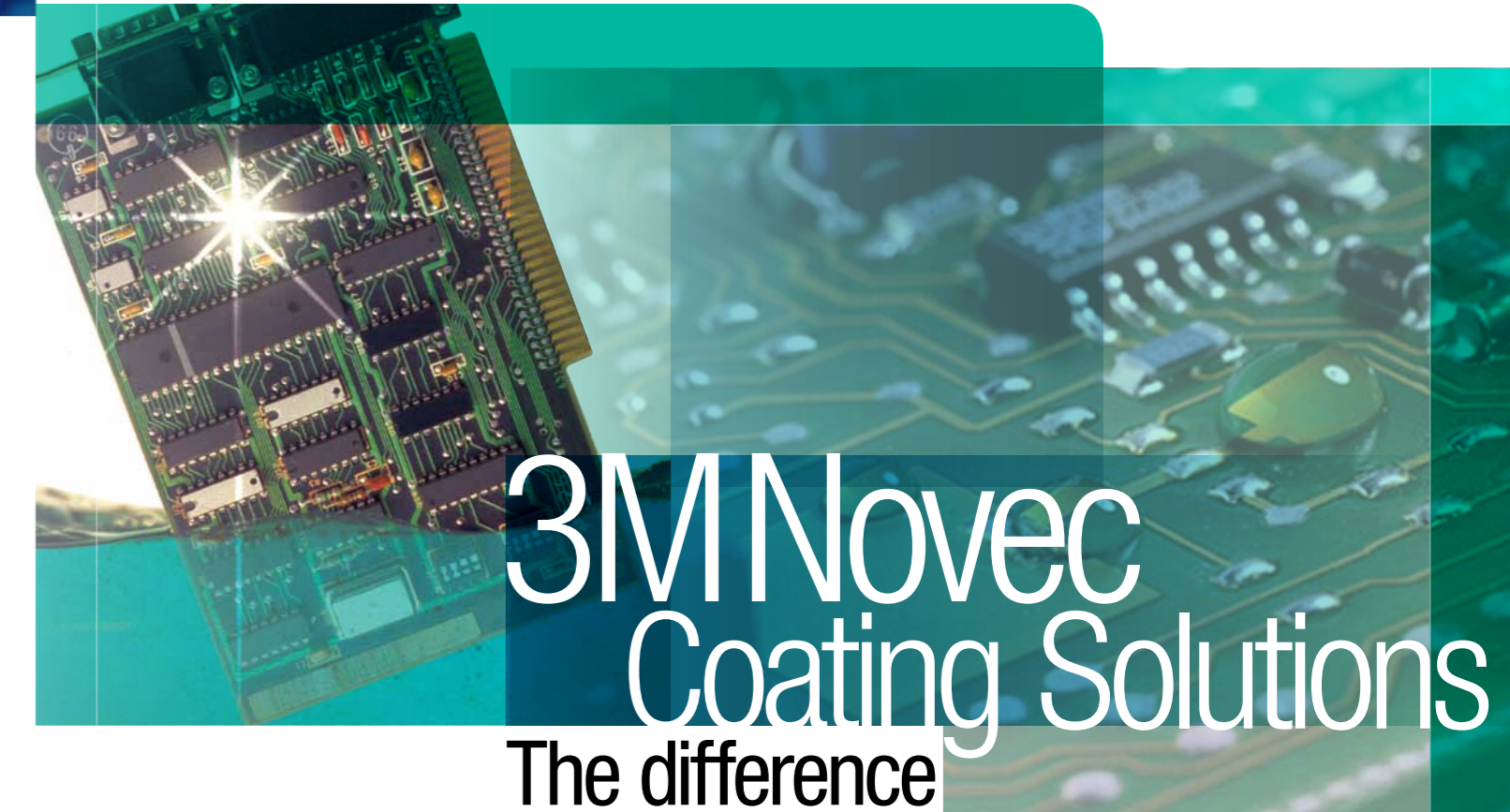
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The difference  
is clear...

Visit [www.3M.co.uk/noveccoating](http://www.3M.co.uk/noveccoating) and go to the Forum where you can quiz Mark to get the best coating solution for you.

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## Why use Coating Solutions?

Electronic coatings are chemicals which when applied to an electronic assembly provide functional protection without affecting the components' performance. The protection is provided against hazards such as chemicals (e.g. fuels, coolants), moisture, temperature, humidity and vibrations. Coatings isolate circuitry from such harsh environments by forming a barrier which protects the printed circuit board (PCB), thereby reducing failure rates, improving product reliability and significantly extending lifespan.



## Conformal Coatings - the traditional approach

Conformal coatings provide a thin protective film which conforms to the contours of an electronics circuit assembly. Coatings are applied via dipping, brushing or spraying the solution directly onto the assembly. Coatings are applied with varying degrees of thickness but are typically greater than 30 microns thick. Coatings are available in a range of technology materials; typically acrylic, silicone and polyurethane, depending on the suitability for an application.

## Surface Modifiers - the alternative to conformal coatings

3M have developed a range of coating products to add to the 3M™ Novec™ family of chemical solutions. 3M Novec Surface Modifiers provide a high performing alternative to conformal coatings. The product range has been designed to deliver;

- excellent protection and repellency properties
- improved manufacturing efficiencies in the coating process
- health & safety and environmental benefits.

A Surface Modifier provides protection by creating a thin, one micron layer of protection which when applied to an electronic assembly dries to a clear, uniform film. Surface Modifiers coat all surfaces of a component to reduce the surface energy enabling exceptional repellency of moisture and particles. Novec Surface Modifiers deliver on manufacturing efficiencies as there is no requirement for masking of PCB contacts and the thin layer of coating can dry in under 7 minutes. The thin layer of protection does not disrupt electrical conductivity and will therefore not affect product performance. Novec chemicals are non flammable, low in toxicity and display excellent environmental properties.

# Excellent Protection & Repellency

## The coating effect:



Coloured water tested on untreated and 3M Novec treated glass slide and blotting paper sheet. The tests demonstrate the unique repellency properties of both substrates when treated with a 3M Novec Surface Modifier.

## Selecting the right coating for you

Selecting the correct coating for a PCB is critical to attaining adequate levels of protection and product performance, in addition to consideration of the deliverables from manufacturing efficiency and health and safety benefits. There are a range of conformal coating technologies available and to achieve the potential benefits

requires the correct selection for each application. The following comparison guide evaluates the conformal coating alternatives alongside the 3M™ Novec™ Surface Modifier range to demonstrate the capabilities of each technology. Note these are general values and do not necessarily represent specific product capabilities.

Physical (Liquid) Properties							
	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
% Solids	2%	2%	25 - 40 %	25 - 40 %	100%	25 - 50 %	100%
Viscosity	0.61 mPa.S	0.61 mPa.S	200 - 750 mPa.S	500 - 1200 mPa.S	100 mPa.S	100 - 5000 mPa.S	300 - 600 mPa.S
Flash Point	None	None	Yes (<15°C)	Yes >74°C	Yes >80°C	Yes <30°C	Yes (100 - 120°C)

The flash point can affect the equipment required during the coating process and the safe usage of the electronic assembly.

Physical (Coating) Properties							
	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
Coating Thickness	<1micron	<1Micron	75 - 150 Micron	75 - 150 Micron	75 - 150 Micron	75 - 150 Micron	125 - 260 Micron
Coverage	19m2/Ltr	40m2/Ltr	6m2/Ltr	6m2/Ltr	6m2/Ltr	6m2/Ltr	6m2/Ltr
Surface Energy	14-15 mN/m	15-16 mN/m	38 mN/m	38 mN/m	N/A	N/A	N/A
Temperature Range	-50 to 200°C	-65 to 175°C	-65 to 150°C	-65 to 150°C	-65 to 150°C	-65 to 125°C	-65 to 200°C
Health & Safety Profile	Excellent	Excellent	Poor	Good	Good	Poor	Good

Surface Modifiers are an effective thin layer of coating, which does not affect the electrical properties of the component. A low surface energy indicates a high repellency. A wide temperature range assists with coating choice and the health & safety profile indicates likely additional costs incurred in production.

Manufacturing							
	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
Drying Time	<5min	<5min	30mins	24hrs	N/A	1 Hour	10 - 30 Mins
Curing time	30min @ 80°C	Not Required	30min @ 77°C	1week	4hrs @ 80°C (Shadow)	30hrs @77°C	10mins @ 100°C
Masking/De-masking required	No	No	Yes	Yes	Yes	Yes	Yes
Preferred Application method	Dip	Dip	Spray	Dip / Spray	Spray	Dip / Spray	Dip / Spray
Optically Clear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stripable	No	Yes with HFE-7100	With Solvent	With Solvent	With Solvent	With Solvent	With Solvent
Solder-through Repairability	Yes	Yes	Yes	Yes	Yes	No	No

Drying and curing times can greatly affect the total manufacturing resource and energy requirements. Surface Modifiers are unique in offering a coating which does not require components to be masked during the coating process. Re-work is important to minimise waste and repair costs. Surface Modifiers are so thin that they can be re-coated without affecting the surface of the component.

Repellency Properties							
	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
Water	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Oil	Excellent	Excellent	Poor	Poor	Poor	Excellent	Good
Solvents	Excellent	Excellent	Poor	Poor	Poor	Excellent	Good

Excellent repellency helps to extend product lifespan, avoiding corrosion and faults in electronic components.

Approvals							
	3M™ Novec™ EGC-2702	3M™ Novec™ EGC-1700	Acrylic (Solvent)	Acrylic (Aqueous)	Acrylic/Urethane (UV Cure)	Polyurethane	Silicones
Thermal Cycling (IEC 68-2-14)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Humidity (BS3900 F9 / ISO 6270-1:2001)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Fungal growth (IPC-TM-650 2.6.1.1)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Surface Insulation Resistance (SIR) (IPC TM-650 2.6.3.4 & IPC-B25A test boards, pattern D)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
UL 746 E Registration	Qualified	Qualified	Normally Qualified	Normally Qualified	Normally Qualified	Normally Qualified	Normally Qualified
UL 94 V(0)	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Each technology can have a benefit providing it is used within a suitable application. Some of the key advantages and limitations of the coating technologies are summarised below.

## 3M™ Novec™ Surface Modifiers

Advantages	Limitations
No requirement for masking reduces coating process times and manufacturing costs	Whilst 3M Novec Surface Modifiers have a relatively high cost per litre, the coating is applied in a one micron thick layer which results in a high square meter coverage per litre
Wide operating temperature range, non flammability and low toxicity support health and safety profile	
Shortened application times - EGC 1700 requires no curing and the full coating process can be completed in 8 minutes	

## Acrylics (Solvent & water based)

Advantages	Limitations
Coating can be removed and PCB reworked	Limited repellency and low resistance to chemical exposure or abrasion
Whilst aqueous based acrylics can take up to a day to dry and a week to cure, solvent based acrylics can dry within one hour	Acrylics are limited to approx 125°C, limiting the usefulness in high heat environments
Providing health and safety considerations are made acrylics are relatively easy to apply	Low flashpoint bears risk on health and safety during manufacturing which could require protection measures and costs

## Silicones

Advantages	Limitations
Coatings can withstand a wide range of operating temperatures	Unable to conduct solder through repairs which could result in wastage or timely repairs
Good health and safety profile and low toxicity levels	High coating thickness could affect the overall dimensions of the electronic component
Thickness of coating is good for applications requiring vibration dampening	Overall moisture protection is limited vs. alternative technologies

## Polyurethanes

Advantages	Limitations
Provide good resistance to abrasion and humidity	Restricted operating temperature range relative to alternative technologies
Coatings can have outstanding dielectric properties providing coating process is well monitored and maintained	UV cure can require secondary cure leading to high overall curing costs and process time
	Manufacturing requires close, resource dependent controls of coating and curing to prevent bubbles forming which can crack coatings

