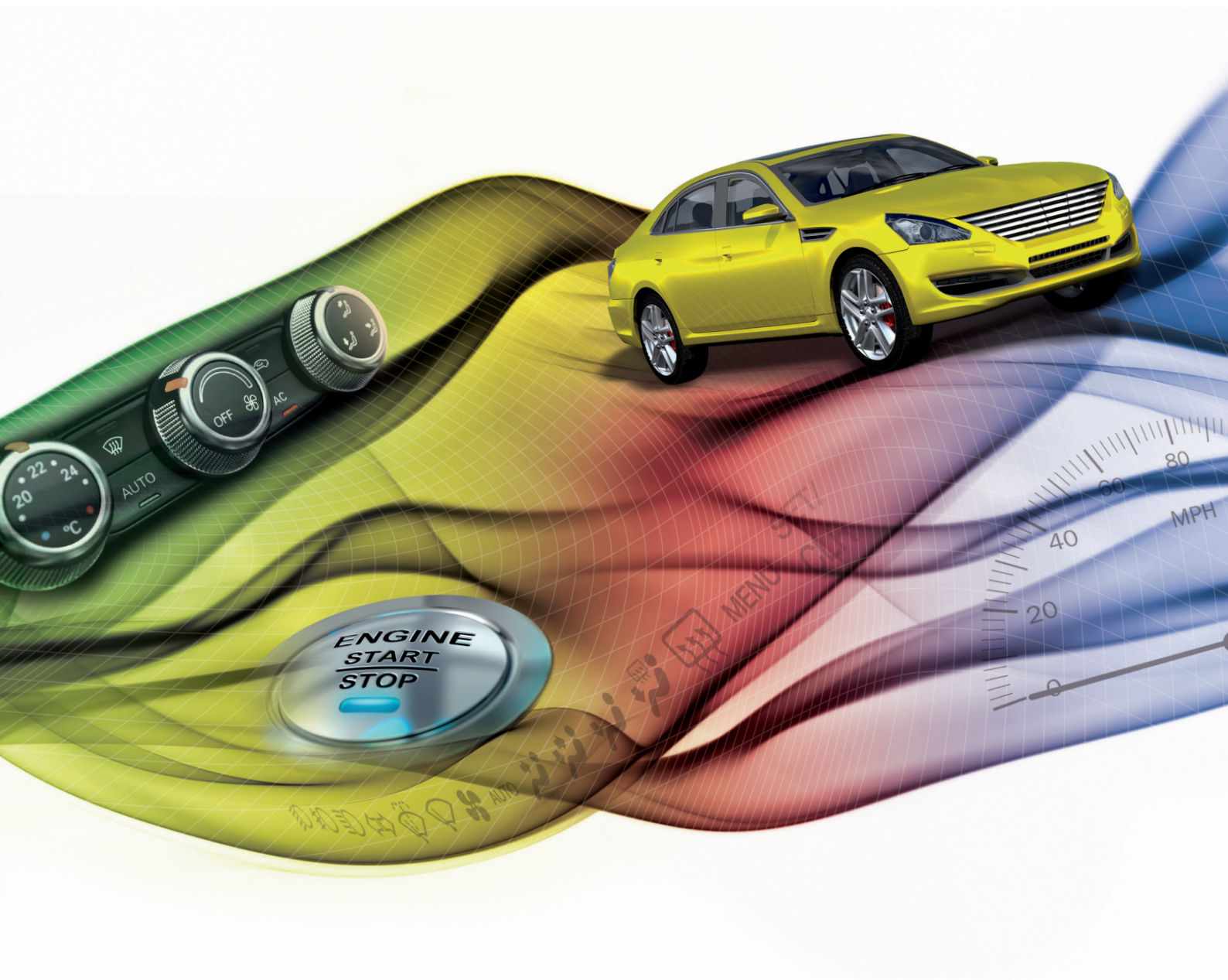


# Driving Advances in Automotive Performance

Engineered to meet the exacting standards of the automotive industry



**ELECTROLUBE**  
THE SOLUTIONS PEOPLE

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# Committed to Improving Performance

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Since 1941, Electrolube have been developing solutions to advance engineering and enhance technological performance. With our expansive range of products and a commitment to push the boundaries, there is no end to the applications of electro-chemical solutions; including our contributions towards improved capabilities within the automotive industry.



## Our Mission Statement

To strive to exceed our customers' expectations with innovative new products and the highest possible levels of customer service.

# Meeting the Highest Demands



The global automotive industry is one of the key sectors within the electronics market. Due to the increasing demands of consumers and the high level of competition within the industry, its rapid development and expansion has positioned it at the forefront of electronics applications. Specifications are frequently reviewed in order to establish the best possible performance from any electronic device in the vehicle. Such specifications are amongst the most difficult for electronics devices to achieve, once again confirming the expectations and desire of this industry to achieve the optimum performance for its customers.

In a typical car today, electronic systems are critical to the smooth and safe operation of the vehicle. Even before the engine starts, electronics have already unlocked the car. Once you start the engine and step on the accelerator, sensors assist in moving out of your parking space, engine control units (ECUs) tune the engine performance, monitor the pressure of the tyres and safety systems are powered up in standby mode. As you prepare for your journey, adjust the air conditioning, ensure your phone is connected to the entertainment system, set your destination on the satellite navigation system and initiate your favourite music, yet more electronic systems are brought to life.

The electronics continue to manage your interior temperature through the Heating, Ventilation & Air Conditioning (HVAC) system. Sensors and control systems detect crash situations, deploy airbags and side impact protection and can automatically notify the emergency authorities of the location of an accident, should the driver be incapacitated. Braking is controlled to prevent dangerous situations such as locked brakes, automatic transmission and management systems are used to change gears, maximise fuel efficiency, monitor and minimise emissions. Active collision detection systems use cameras and radar systems to alert drivers of impending situations and prevent lane drift.

The usage of automotive electronics appears set for continuous development as consumers demand ever more performance, safety, comfort, convenience and entertainment from their vehicles. Systems are being developed that will do more to avoid accidents, protect and entertain occupants and reduce the environmental impact of the journey. With electronic systems often exceeding 20% of the total vehicle value and vehicle warranties typically offered for 5 to 7 year durations, reliability of these electronic systems is vital. Combined with the requirement for 'greener', more efficient vehicles, innovation and cooperation are key to achieving the highest targets in this field.

With our expansive product range of formulated chemical products, we supply leading manufacturers of electronic devices for the automotive industry, amongst others, thus offering the '**complete solution**' at all levels of protection. With a strong emphasis on both research and collaboration, we are constantly developing new and environmentally friendly solutions for our customers. Our unrivalled, very personal customer service also extends to every corner of the world. You can rely on our experienced staff to be knowledgeable and up to speed with the latest technological developments. Having a named single point of contact helps ensure we work closely with our customers, solving problems clearly and efficiently.

## Problem

PCB within the ECU is failing due to condensation forming on critical areas.

## Solution

2K500 Conformal Coating provides excellent coverage over difficult geometries. It offers a high level of resistance to humidity and condensation as well as resisting even the most extreme thermal shock conditions.



**ELECTROLUBE®**  
THE SOLUTIONS PEOPLE

GB Planning, Filamentary  
in conductive  
Harmonized Project, Kinet  
Boreman's War, Surface  
various. Water protection  
protection - Heat protection







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## Thermal Management

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With increasing requirements for efficient electronic products at ever decreasing sizes, thermal management products are becoming more and more essential to the reliability of electronic devices. Our thermal management products can be used to improve the efficiency of heat transfer at the interface of two mating materials, where heat is being dissipated from one to the other. In addition, our products can also be used to fully encapsulate and dissipate heat away from the entire device.

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## Contact Lubrication

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Contact lubricants are specially formulated greases and oils that reduce friction and enhance the electrical performance of current carrying metal interfaces in switches and connectors. Offering enhanced performance and lifetime of all types of switches and contacts, our lubricants provide a smooth, high quality feel of moving parts, resulting in their use by major automotive brands around the world.

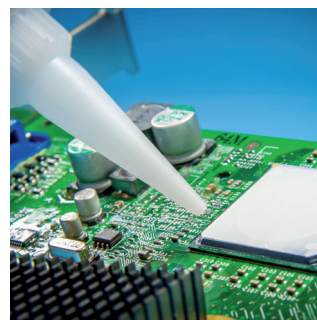
### Requirement

Enhanced electrical performance and lubricity required for dashboard vehicle controls.

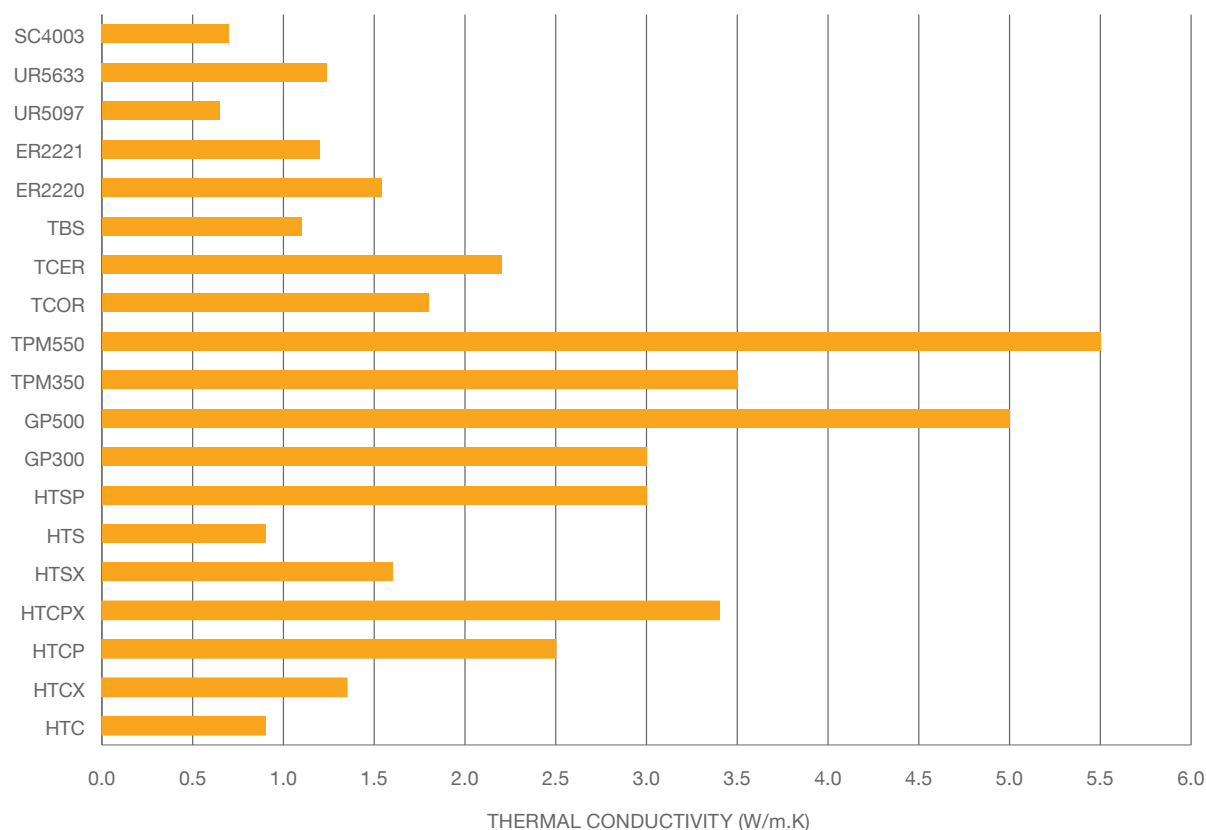
### Solution

LCG offers excellent electrical performance for low current carrying switches, prolonging the lifetime and efficiency of the contact surface. The movement and feel of the switch will also be greatly improved.

# Product Testing and Performance



Thermal conductivity, measured in W/m.K represents a materials' ability to conduct heat. Bulk thermal conductivity values give a good indication of the level of heat transfer expected, allowing for comparison between different materials. Relying on bulk thermal conductivity values alone will not necessarily result in the most efficient heat transfer, however. Users must address bulk thermal conductivity values in conjunction with the contact resistance of the surfaces the material is to be applied to and also consider the most appropriate application thickness in order to successfully achieve the optimum in heat transfer efficiency.



## Requirement

Protection of a fuel level sensor from diesel oil.

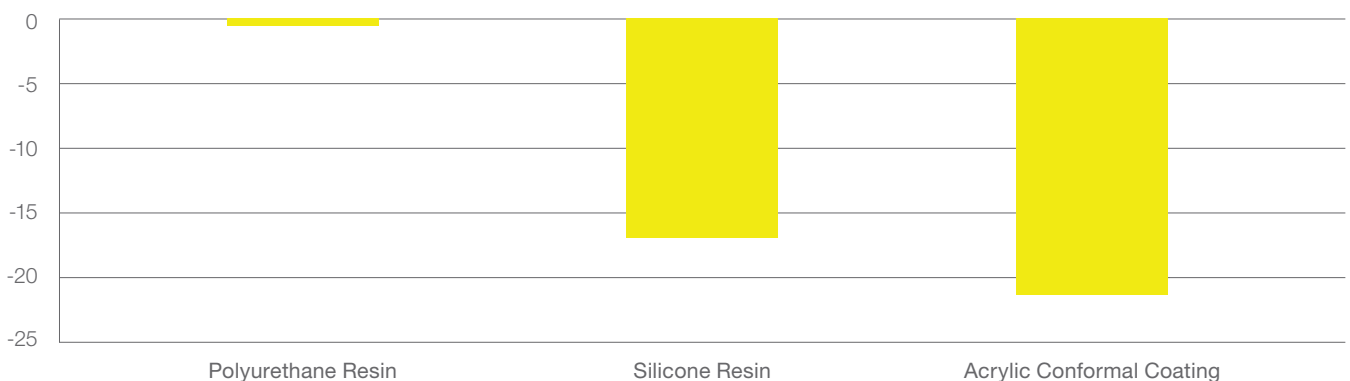
## Solution

ER2223 is an Encapsulation Resin that offers excellent resistance to a wide range of chemicals and oils. Potting the sensor in this resin will help to protect it from the harsh application environment.



LEDs are widely used in the automotive industry and can be subject to a variety of conditions, just like other electronic applications discussed. Conditions such as salt mist, chemical or corrosive gas environments can pose a difficult challenge for the long term performance of LED products. Corrosive gases can be of particular concern, due to the permeable nature of an LED lens. If corrosive gases enter the LED, they can lead to discolouration and reduction in luminous flux. Selecting the correct protection medium can prevent such issues from occurring and ensure the longevity of the device.

## % Change in Luminous Flux after Mixed Corrosive Gas Exposure



When considering the protection and performance of electrical switches and contacts, it is also important to consider the performance in humid or corrosive environments. In order to establish which products provide the highest level of protection in high humidity and corrosive environments; test panels were coated with Electrolube Contact Lubricant products and subject to 90%RH, 35°C for 3 weeks, followed by 1 week in the salt spray chamber using a 5% salt solution.

Grease	% Corrosion on steel	% Oxidation on copper
SGA	40	100
SGB	100	0
CG53A	10	0
CG60	5	10
CG70	5	70
CG71	50	10
CTG	5	0

The results are comparisons, therefore 100% relates to the highest level of oxidation observed on all test substrates.

### Requirement

Improve the efficiency of a battery within an electrical vehicle.

### Solution

Utilise a heat transfer paste such as HTCX to improve the efficiency of heat dissipation from the battery and reduce the operating temperature.



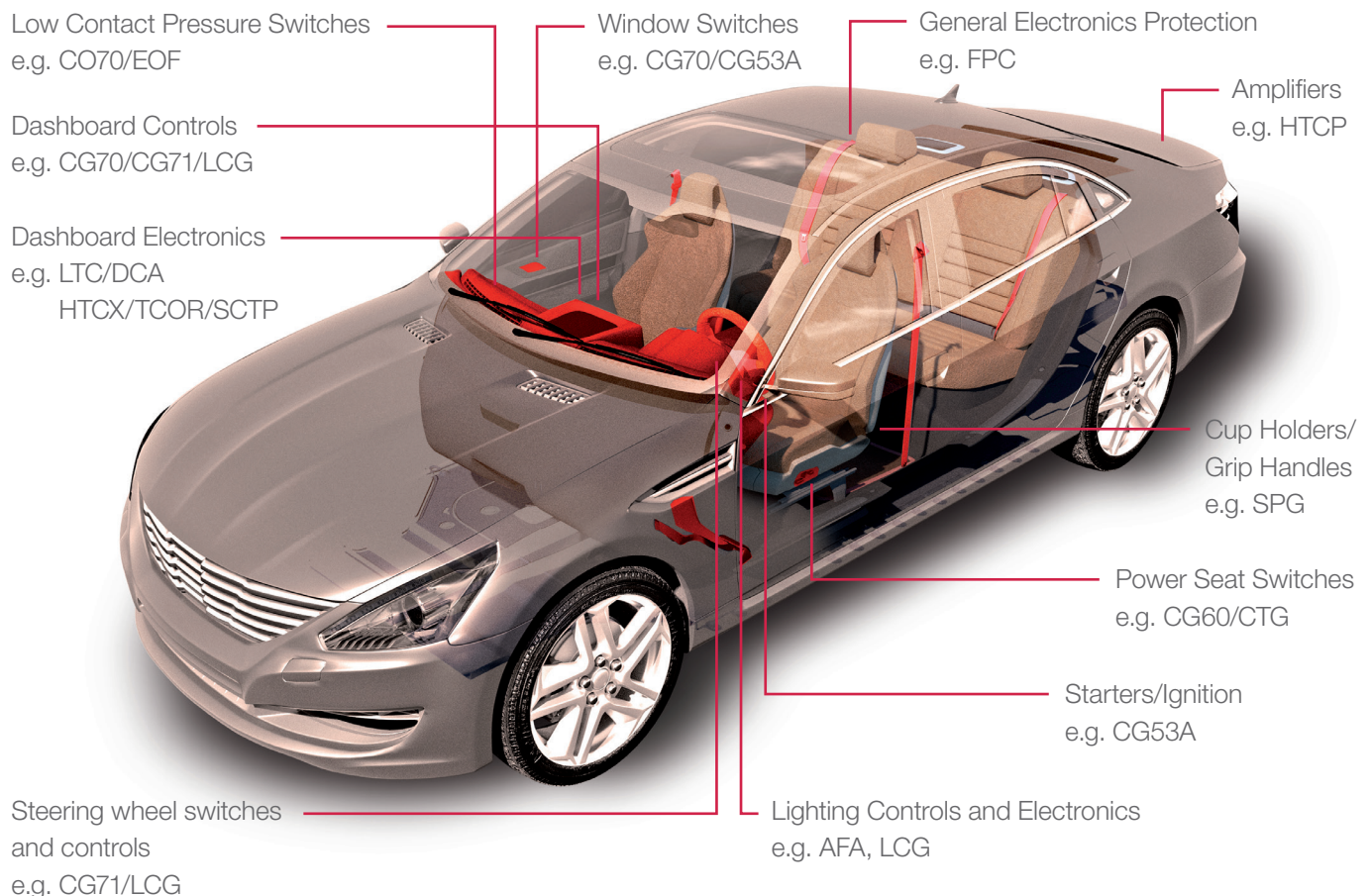
# Interior Solutions



Electronic sensors and systems situated in the passenger cabin, essentially occupy the same space as the vehicle occupants and are therefore exposed to largely similar environments. In the winter that can mean extreme cold and the tendency towards a condensing atmosphere. In the summer, the tendency is towards a warm and humid atmosphere.

Condensation and high humidity are both a risk to the reliability of electronics, by promoting the formation of corrosion. In addition to these factors, the electronics may be exposed to atmospheric pollutants, cleaning solutions, liquid splashes etc. Any of these factors may be a potential reliability risk, especially in association with humidity and condensation.

The vehicle interior also contains a variety of switches and connectors to control many different functions. The lifetime, functionality and quality of these controls can have a dramatic impact on the performance expectations of the vehicle and the perceived brand image. A lubricated switch is subject to far less mechanical wear as the lubricant facilitates smooth movement. Friction, wear and electrical issues such as fretting corrosion and arcing are therefore greatly reduced, extending switch lifetime, improving electrical efficiency and allowing the use of a wider selection of materials.





# Under-Hood Solutions



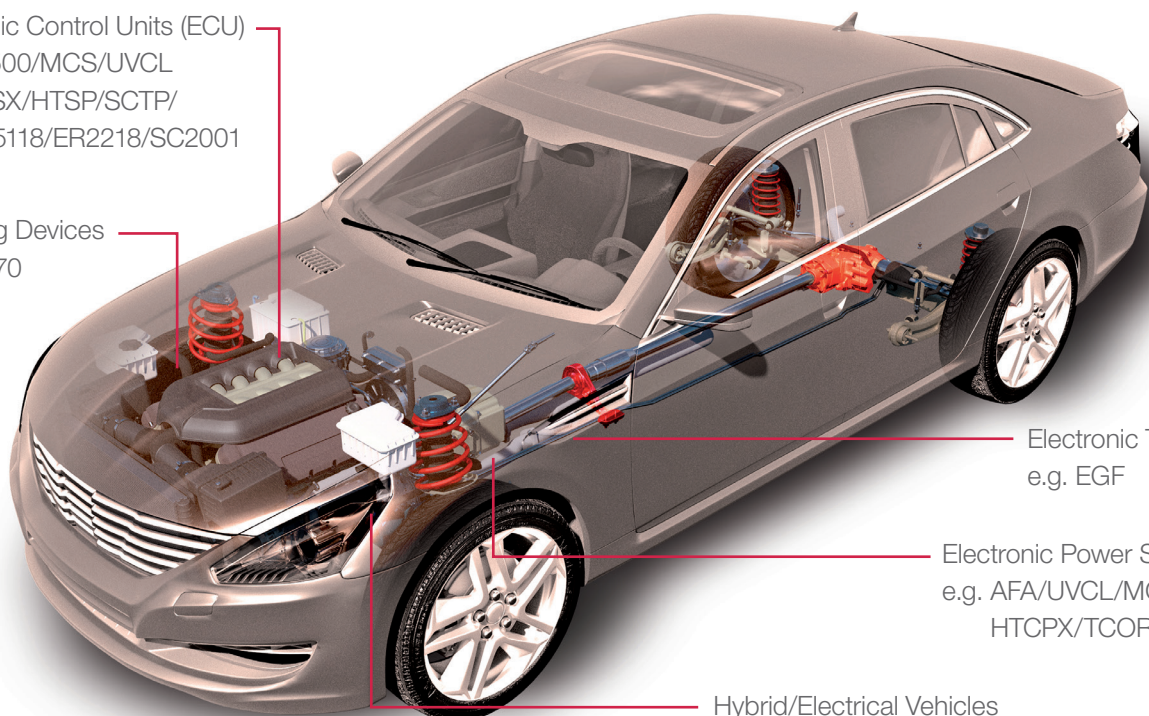
The main differences between the requirements for the protection of 'under-hood' electronics and interior electronics are due to the placement of the former. The environment can be much less controlled, with higher maximum operating temperatures and far more opportunity for contamination by fuels, oils, cleaning fluids, corrosive gases, metal particulates and salt water sprayed up after road gritting etc.

Under-hood electronics are also subject to much more vigorous test conditions, with thermal shock being at the forefront of the testing requirements. Due to the variety of possible climates and the frequent changes in temperature through the operation of the vehicle, it is imperative that any product used to enhance performance can also resist and continue to offer the required protection in such a difficult and varied environment.

Due to such a varied environment, thermal management of electronic devices is essential to prolong the lifetime of the product and ensure efficient and consistent performance, particularly in safety critical functions. In short, 'under-hood' and other exterior electronic assemblies are required to provide protection and enhance performance under much tougher environmental conditions.

Electronic Control Units (ECU)  
e.g. 2K500/MCS/UVCL  
HTSX/HTSP/SCTP/  
UR5118/ER2218/SC2001

Slip Ring Devices  
e.g. CO70



Electronic Throttle  
e.g. EGF

Electronic Power Steering  
e.g. AFA/UVCL/MCS  
HTCPX/TCOR

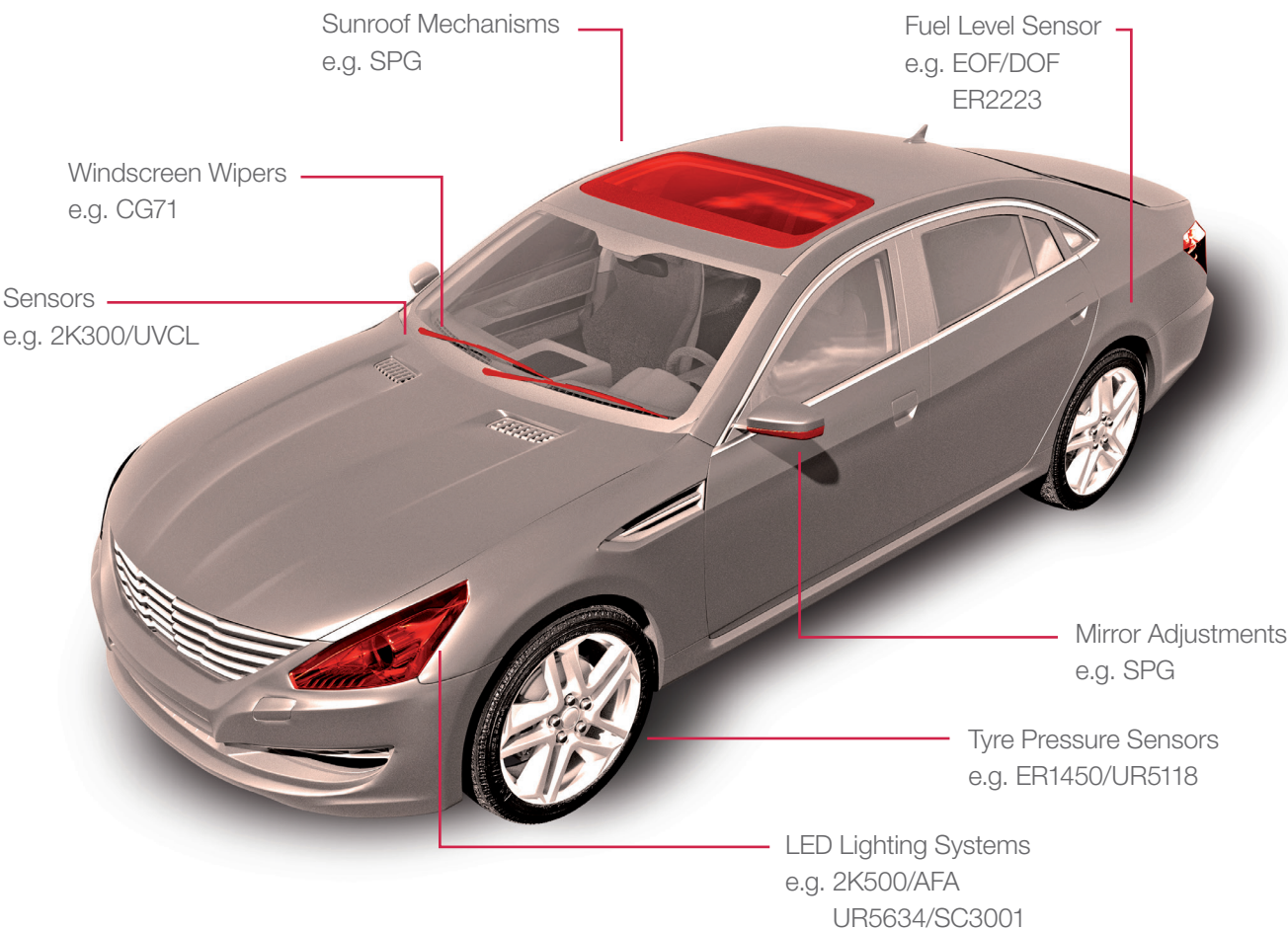
Hybrid/Electrical Vehicles  
– High Voltage Insulation: e.g. ER4001  
– Thermal Management: e.g. HTCX

# Exterior and Lighting Solutions



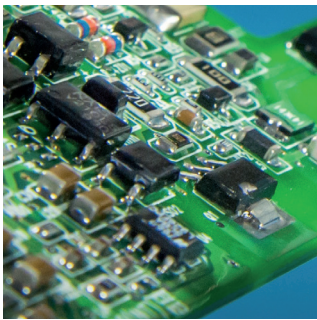
Exterior applications can be wide ranging; whether it be sensors relaying information from different parts of the vehicle, or individual motors powering windscreen wipers, for example. The vast array of Electrolube products available means that solutions can be provided in a wide range of options.

The lighting industry is another rapidly expanding market, particularly with the continual growth and development of LED solutions. Due to the design freedom and enhanced performance LED systems offer, applications are becoming more diverse and challenging and whilst achieving the desired aesthetic effect, the reliability and lifetime of the product must also be considered. Electrolube products can be used to assist Design Engineers in protecting LED systems in a variety of conditions, including those with rapid temperature excursions or corrosive environments.

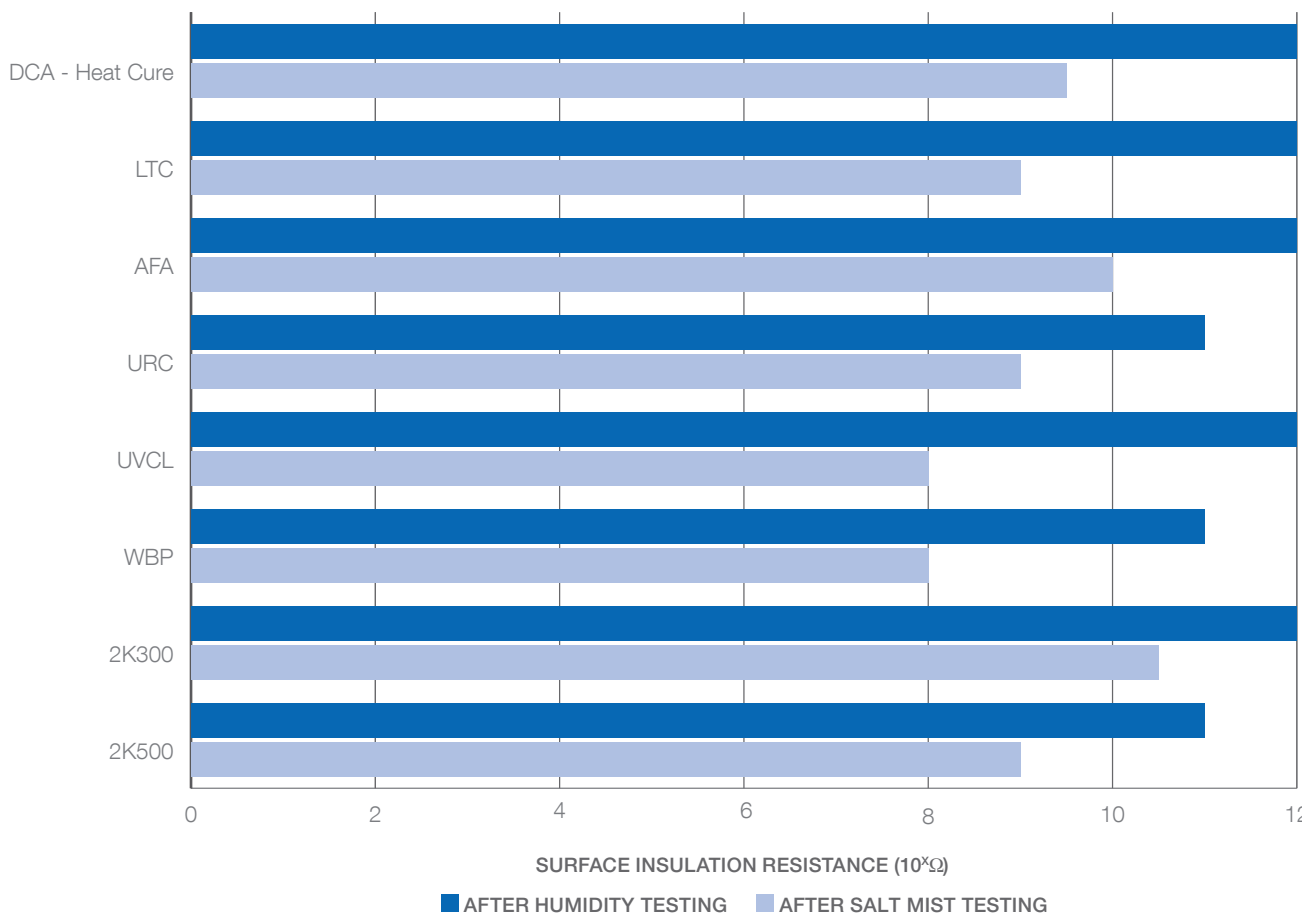


# Product Testing and Performance

## Salt/Humidity



Environmental testing consists of exposing coated PCBs or test coupons to a variety of challenging conditions. The graph below shows results from humidity tests; 85-90% RH, 40°C, 50V DC for 168 hours, and salt mist tests; IEC 60068-2-11 5% salt solution, 35°C for 168 hours.

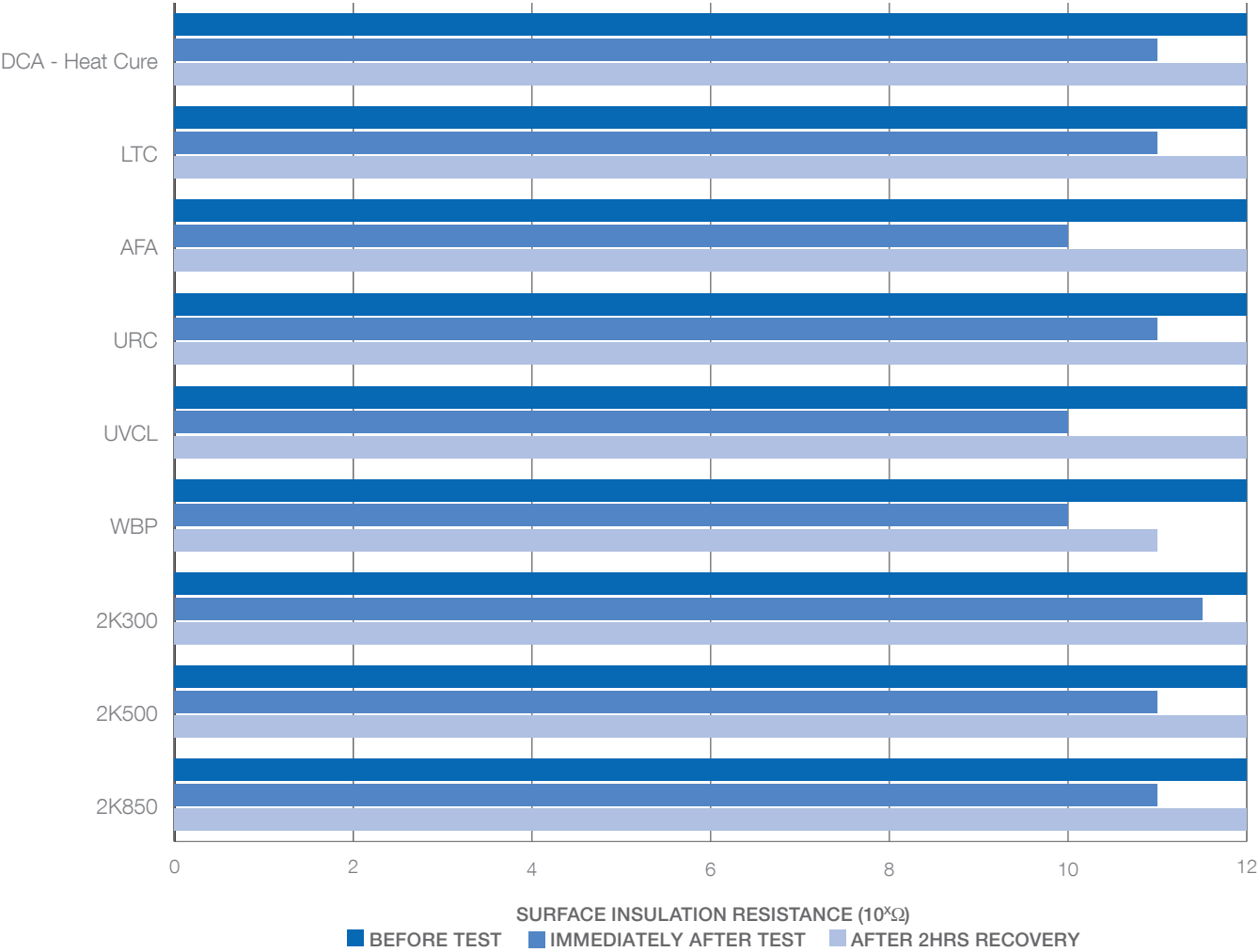


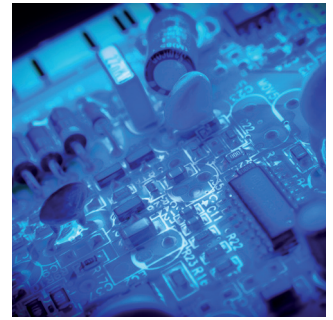




# Corrosive Gas

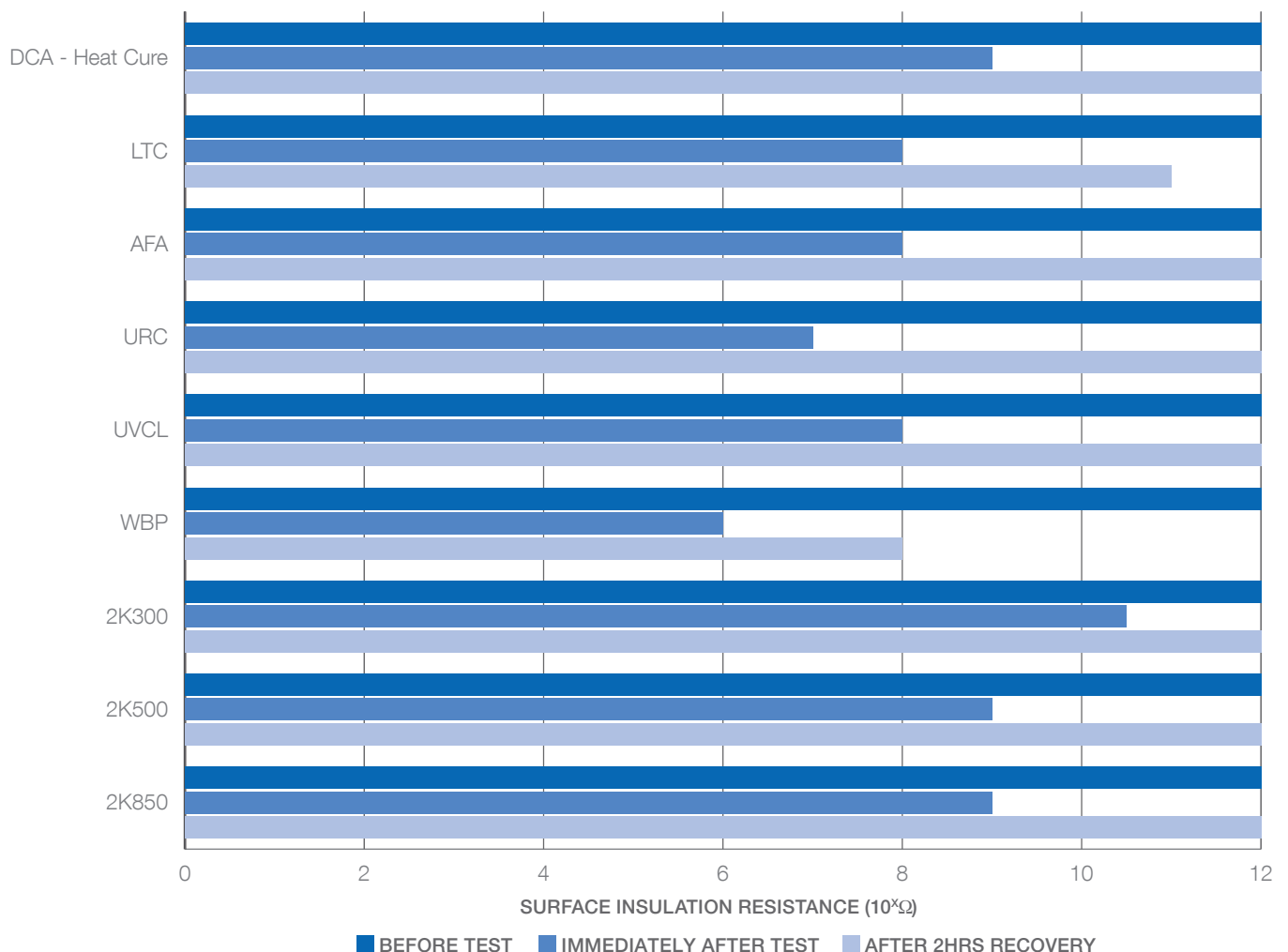
Corrosive gas testing involves exposing PCBs to a mixed gas environment combining hydrogen sulphide and sulphur dioxide. The graph below shows surface insulation resistance (SIR) measurements following exposure to mixed corrosive gas according to BS EN 60068-2-60 Method 1.





## 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 exposure can highlight issues. Coated boards were immersed in water for 7 days and the SIR results compared. For continuous or frequent immersion in water, we recommend Electrolube Encapsulation Resins.



## BMW Group Standard

2K300, 2K500, UVCL, AFA, LTC and DCA have passed qualification to BMW Group Standard GS95011-5.

# Conformal Coatings



	AFA	DCA	HFAC	LTC	MCS	URC	UVCL	WBP/ WBPS	2K300	2K500	2K850	FPC
	Aromatic Free Acrylic	Silicone Conformal Coating (SCC3)	Acrylic Conformal Coating	Low Temperature Coating	Moisture Cure Silicone Coating	High Performance Urethane Coating	UV Cure Conformal Coating	Aquacoat Plus/ Sprayable	High Performance Solvent Free Urethane	High-Performance Solvent Free Urethane	Unique UV Cure & Chemical Cure	Ultra-Thin Coating
Colours Available	Clear	Clear/ Black/Red	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Red	Clear
Viscosity (mPa s @ 20°C) (Bulk)	175	200	360	150	500	240	150	200/80	*Sprayable	*Sprayable	sprayable*	2
Flashpoint (°C) (Bulk)	-7	27	12	-4	None	27	>90	None	>100	>100	>100	None
Solids (%) (Bulk)	35	37	25	23	100	43	100	35	100	100	100	2
Dielectric Strength (kV/mm)	45	90	45	80	90	80	27	50	90	90	90	90
Insulation Resistance (Ω)	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>16</sup>	7 x 10 <sup>12</sup>	5 x 10 <sup>11</sup>	2 x 10 <sup>16</sup>	5 x 10 <sup>12</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>
Temp. Range (°C)	-65 to +125	-70 to +200	-65 to +125	-65 to +130	-65 to +200	-40 to +130	-65 to +135	-60 to +125	-65 to +150	-40 to +130	-40 to +130	-40 to +200**
Touch Dry Time (Mins @ 20°C)	15-10	50-55	20-30	10-15	<10	15	–	25-35	240	240	UV	1-5
Cure Time (Hours @ 20°C)	24	2 @ 20°C & 2 @ 90°C	24	24	24	24	–	24	10 mins @ 80°C	10 mins @ 80°C	<120	24
Solvent Resistance	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
Humidity Resistance	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
Mould Resistance	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
Thinners	FTH	DCT	MDT	LTCT	N/A	LOT	N/A	DI Water	2KPB0	2KPB0	2KPB0	HFS
UV Trace	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes
Approvals	UL746, IPC-CC-830, IEC61086 (Meets) BMW GS95011-5	UL746	Meets UL746	IPC-CC-830, IEC61086 (Meets) BMW GS95011-5	Meets IPC-CC-830	Meets IPC-CC-830	UL746, IPC-CC-830, (Meets) BMW GS95011-5		(Meets) BMW GS95011-5, IPC-CC-830	(Meets) BMW GS95011-5, IPC-CC-830	Yes	UL746

Please refer to the technical data sheet for more information on UV Curing Parameters.

\* The 2K Range has been formulated for optimal application with specific applicators, designed purposively for 2K conformal coatings, by suppliers such as Norsdon Asymtek and PVA. Please refer to the technical datasheet or contact us for further information.

\*\*Application and Geometry Dependent

## BMW Group Standard

2K300, 2K500, UVCL, AFA, LTC and DCA have passed qualification to BMW Group Standard GS95011-5.



# Encapsulation Resins



	ER1450	ER2188	ER2218	ER2223	ER4001	UR5044	UR5118	UR5528	UR5604	UR5634	SC2001	SC3001
<i>Specialist Property</i>	Very Low Viscosity	General Purpose	High Temperature Stability	High Temperature Stability	High Temperature Resistance	Soft, 'Dig-outable'	Moisture Protection High Toughness	Tough, High Adhesion	General Purpose / UL Approved	Optically Clear	Heat Cure, High Temp Resistant	Optically Clear
Colour (Mixed System)	White	Black	Black	Black	Off White	Dark Blue	Black	Black	Black	Water White	Dark Grey	Optically Clear
Cured Density (g/ml)	1.10	1.69	1.16	1.10	2.13	1.58	0.99	1.07	1.54	1.11	1.40	1.04
Mixed System Viscosity (mPa s @ 23°C)	250	9000	500	800	4000	3400	2300	2000	2000	1050	3500	1800
Mix Ratio by Weight (by Volume)	2.5:1 (2.2:1)	11:1 (5.5:1)	3.6:1 (2.8:1)	3.45:1 (2.90:1)	11:1 (4.4:1)	13.4:1 (11.7:1)	2.8:1 (3.7:1)	2.4:1 (2.9:1)	5.2:1 (3.9:1)	0.9:1 (1:1)	1:1 (1:1)	13:1 (12:1)
Usable Life (Minutes @ 23°C)	20	60	40	30	60	25	28	20	40	15	30	30*
Gel Time (Minutes @ 23°C)	30	150	50	90	360	40	43	35	90	20	N/A	180*
Cure Time (Hours @ 23°C/60°C)	12/2	24/2	24/4	24/4	24	24/3	36	24/5	24/3	24/4	3 @80°C	24*
Thermal Conductivity (W/m.K)	0.20	0.91	0.35	0.20	1.2	0.60	0.2	0.25	0.45	0.30	0.60	0.20
Temperature Range (°C)	-50 to +130	-40 to +120	-50 to +150	-40 to +180	-40 to +150	-70 to +120	-60 to +125	-50 to +125	-40 to +130	-40 to +120	-50 to +200	-60 to +200
Maximum Temperature – Short Term (°C)	+150	+140	+245	+210	+170	+130	+130	+130	+155	+130	+225	+250
Dielectric Strength (kV/mm)	12	16.6	10	12	17.7	17.7	18	25	18	11	20	-
Volume Resistivity (Ω•cm)	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>15</sup>	10 <sup>10</sup>	10 <sup>10</sup>	10 <sup>15</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>15</sup>	10 <sup>14</sup>
Shore Hardness	D50	D85	D55	D80	D90	A40	A80	D57	A75	A80	A50	A20
Flame Retardency Level	-	V-0	V-0	-	V-0	V-0	-	-	V-0	-	V-0	HB
UL94 Approval	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No
RoHS Compliant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

For exact calculated ratios please see the technical data sheet. \*Cure times will be dependent on ambient humidity

# Contact Lubricants



	CG53A	CG60	CG70	CG71	CG80	CTG	EGF	LCG	SGB	SPG
<i>Specialist Property</i>	High Voltage	Plastics Compatibility	Low Temperature Performance	Electrical Performance	High Temperature Performance	Moisture Resistance	High Temperature	Electrical Performance	General Purpose	Plastic Mechanical Lubrication
Pour Point (base oil, °C IP-15)	-37	-54	-70	-70	-35	-62	-25	-54	-37	-57
% Evaporation Weight Loss (IP-183 100°C)	0.21	0.30	0.30	0.10	0.20	0.30	<0.10	0.20	0.93	0.20
Drop Point (°C IP-31)	200	200	200	200	200	>200	>250	200	250	>250
Penetration (Worked, Cone, 20°C IP-50)	320	320	320	310	320	330	280	320	320	320
Temperature Range (°C)	-35 to +130	-45 to +130	-55 to +130	-50 to +130	-30 to +160	-50 to +160	-25 to +300	-45 to -130	-35 to +130	-40 to +125
Mechanical Lubrication	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Electrical Performance	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Humidity Resistance*	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Plastics Compatibility**	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
UV Trace	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Oil Version Available	No	No	CO70	No	No	No	EOF/DOF	No	SOB/EML	No

\*Based on accelerated testing. \*\*Compatibility may differ from quoted results – Testing should always take place prior to production.

# Thermal Management



	HTCX	HTCP	HTCPX	HTS	HTSP	HTSX	SCTP	TCOR	ER2221	UR5633	SC4003
	Non-Silicone Heat Transfer Paste Xtra	Non-Silicone Heat Transfer Paste Plus	Non-Silicone Heat Transfer Compound Plus Xtra	Silicone Heat Transfer Compound	Silicone Heat Transfer Compound Plus	Silicone Heat Transfer Compound Xtra	Surface-Cure Thermal Paste	Thermally Conductive RTV	2 Part Epoxy Resin	2 Part Polyurethane Resin	2 Part Silicone Resin
Thermal Conductivity (W/m.K)	1.35	2.50	3.40	0.90	3.00	1.58	1.20	1.80	1.20	1.24	0.70
Density (g/ml)	2.61	3.00	3.10	2.10	3.00	3.10	2.60	2.30	1.88	1.65	1.40
Viscosity/mPa s**	130,000	105,000	640,000	210,000	45,000	275,000	125,000	140,000	6,000	30,000	3500
Cure Time (Hours @ 20°C / 60°C)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	24/NA	24/2	24/4	24/1
Temperature Range (°C)	-50 to +180	-50 to +130	-50 to +130	-50 to +200	-50 to +200	-50 to +200	-50 to +200	-50 to +230	-40 to +150	-50 to +125	-60 to +200
Evaporation Weight Loss (96hrs @ 100°C IP-183)	≤0.40%	≤1.00%	≤1.00%	≤0.80%	≤0.8%	≤0.30%	<0.8%	N/A	N/A	N/A	N/A
Dielectric Strength (kV/mm)	42	42	42	18	18	18	12	>8	10	18	12
Volume Resistivity (Ω-cm)	1 x 10 <sup>14</sup>	1 x 10 <sup>14</sup>	1 x 10 <sup>14</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>15</sup>	1 x 10 <sup>12</sup>	1 x 10 <sup>14</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>14</sup>	1 x 10 <sup>14</sup>

\*Requires moisture to cure, elevated temperatures not recommended unless moisture is present. \*\*This information should be used as a guideline only.



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