LED
A Leading Light

Engineering superior performance
in any environment

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ELECTROLUBE
THE SOLUTIONS PEOPLE

Committed to Improving Performance

Since 1941 we have been developing solutions to advance engineering and enhance technological performance. With our expansive range of products and a thirst to push what's possible, there is no end to the applications of electro chemical solutions; including our contributions towards improved capabilities within the LED industry.

With a strong emphasis on both research and collaboration, we are constantly developing new and environmentally friendly solutions for our customers, old and new.

Because we're represented in over 50 countries, our disciplined network of subsidiaries and distributors can offer all our customers genuine security of scale. This robust supply chain means that when the unexpected happens, we're still capable of delivering a truly bespoke service anywhere in the world.

Our Mission Statement

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

We Have the Solution

Our ambition to constantly adapt and improve the performance of any product has contributed to the extent of our expertise, and resulted in a range of products in Electronic and General Purpose Cleaning, Conformal Coatings, Encapsulation Resins, Thermal Management Solutions, Contact Lubricants, Maintenance and Service Aids. We also offer tailored solutions for those who can't find the perfect solution.

The LED Boom

The LED industry is rapidly expanding offering a vast array of uses for LEDs in all types of lighting, signage and domestic appliance products, to name but a few.

In offering alternatives to halogen, incandescent and fluorescent lighting systems for both interior and exterior applications, the growth of the LED lighting market alone is impressive.

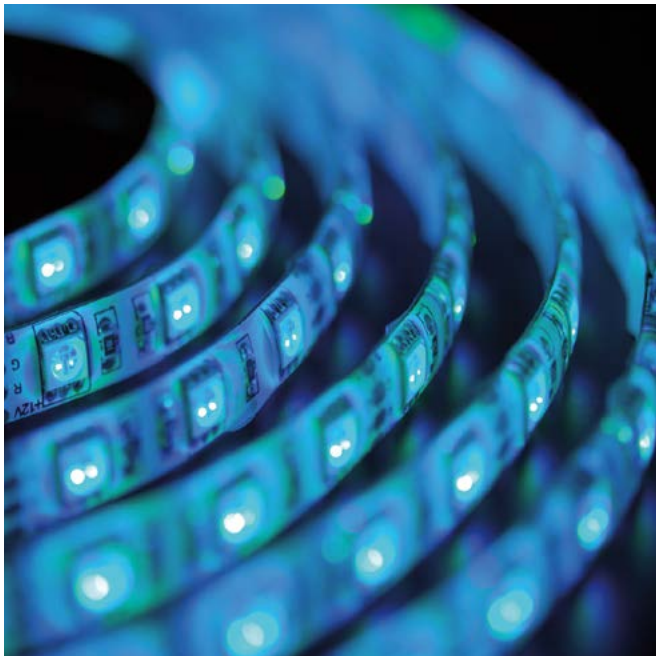
Such growth is attributed to the advantages LEDs offer over traditional lighting forms in terms of adaptability, lifetime and efficiency; they allow more design freedom, offer an exceptionally long life time and they are also considerably more efficient, converting the majority of energy to light and thus minimising the heat given off.

Lighting Designs

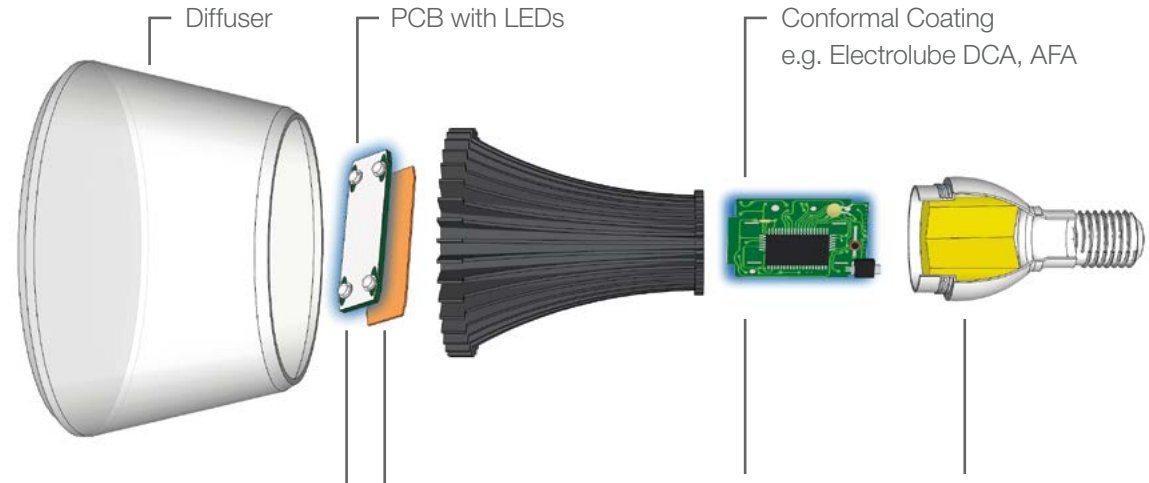
Due to the design freedom an LED offers, applications are becoming more diverse and challenging and whilst achieving the desired aesthetic affect, the reliability and lifetime of the product must also be considered.

Electrolube products can be used to assist Design Engineers in protecting LED systems in a variety of conditions, including the installation of lighting designs in corrosive environments, for example.

Electrolube also offer products that can be incorporated into the design of the product for cosmetic reasons as well as helping to provide key functional improvements such as increased efficiency and reduced energy consumption.



LED Lamp Application



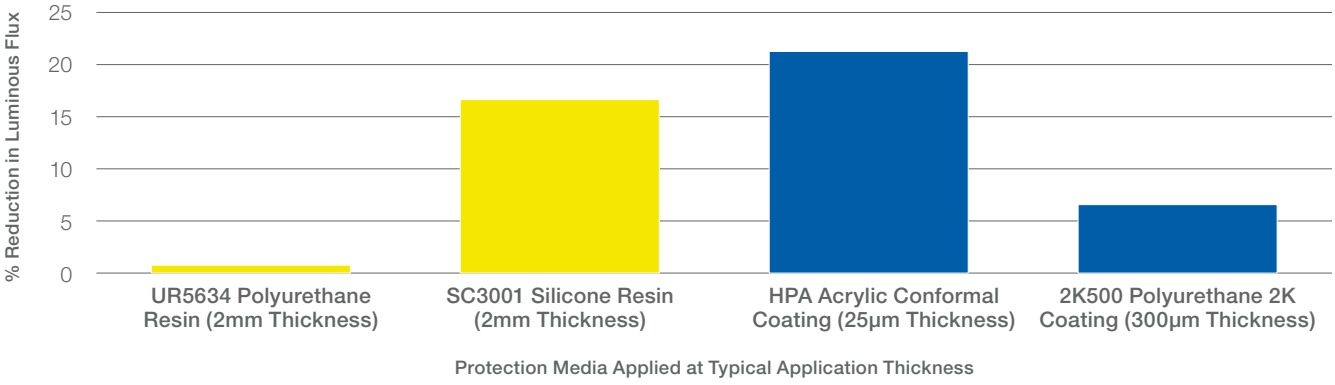
Enhancing Performance in Challenging Environments

The environment that the LEDs and associated electronic components are used in will have an effect on the type of product required to protect the system and ensure reliability.

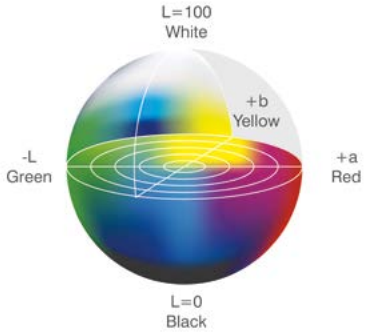
Whether the conditions provide a humidity, chemical, salt mist or corrosive gas challenge, Electrolube can offer conformal coatings and encapsulation resins to enhance performance and ensure reliability throughout the lifetime of the device.

With a wide variety of products available, Electrolube can also offer materials to work in conjunction with particular LED requirements, such as low or zero VOC options, for example.

% Reduction in Luminous Flux after H_2S Exposure



Enhancing LED Performance



Chemistry Options

As well as offering a range of product types, Electrolube also work with a number of different base chemistries to provide solutions for a vast array of applications.

Depending on the product type there are epoxy, polyurethane, silicone, acrylic and non-silicone, synthetic material blends available.

Such a vast array of chemistry types provides a range of properties including toughness, flexibility, high temperature resistance, clarity, chemical resistance, low temperature performance, adhesive strength, to name just a few.

Protection Over the LED – Clarity and Hazy Resin

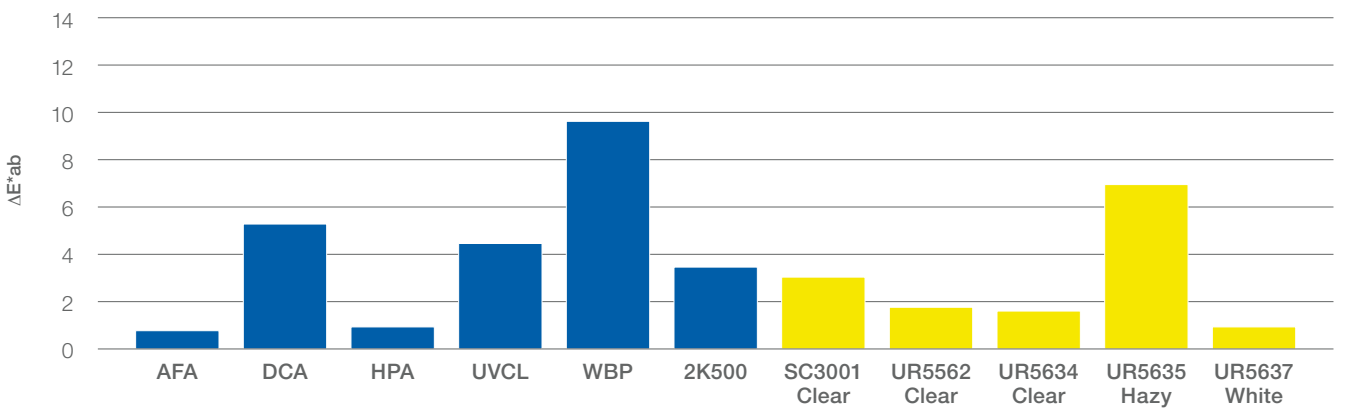
When directly protecting the LED there are a number of factors that must be considered. The clarity of the material applied is crucial to ensure the maximum utilisation of light output from the LED. In addition, any potential changes that can occur over the lifetime of the LED must also be considered.

Electrolube products SC3001, UR5634, UR5635, UR5562, AFA, HPA, APL, have been tested to show their UV stability, utilising a QUV SE Accelerated Weathering Tester and testing for colour change using the L*a*b colour space system. In accordance with ISO 4892, Electrolube resins and coatings were exposed to 1000 hours of UV light; conditions roughly equivalent to 4 years weathering resistance in a Northern European Climate.

Typically categorised by colour temperature, LEDs are also available in a huge number of colour variants. The colour temperature of the LED can be affected by the protection media applied and therefore the potential colour temperature shift should be tested in accordance with the LED used. Electrolube can also offer guidance for the correct selection and application of products in order to find the optimum balance of minimising colour temperature shift whilst obtaining the required protection level.

In addition to offering clear products with a high clarity, Electrolube can also offer solutions such as UR5635, that offer both light dissipation and protection of the LED in one package, thus eliminating the need for diffuser covers in some applications.

Absolute Colour Change (ΔE*ab) following 1000 hours UV Exposure

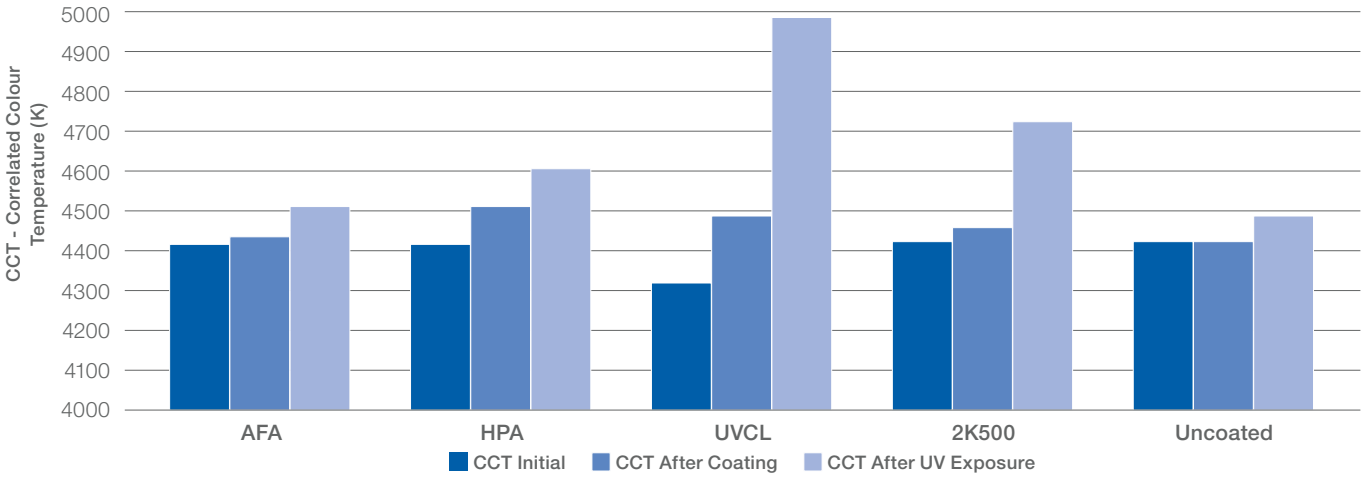


Protection Media Applied at Typical Application Thickness

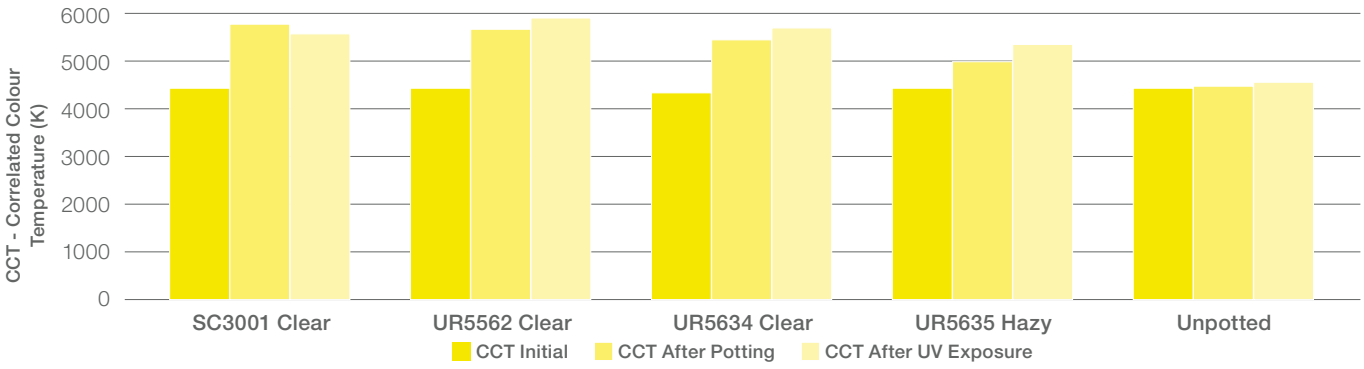
Product Tests

Correlated Colour Temperature (CCT) Changes: 1000 hours UV Exposure

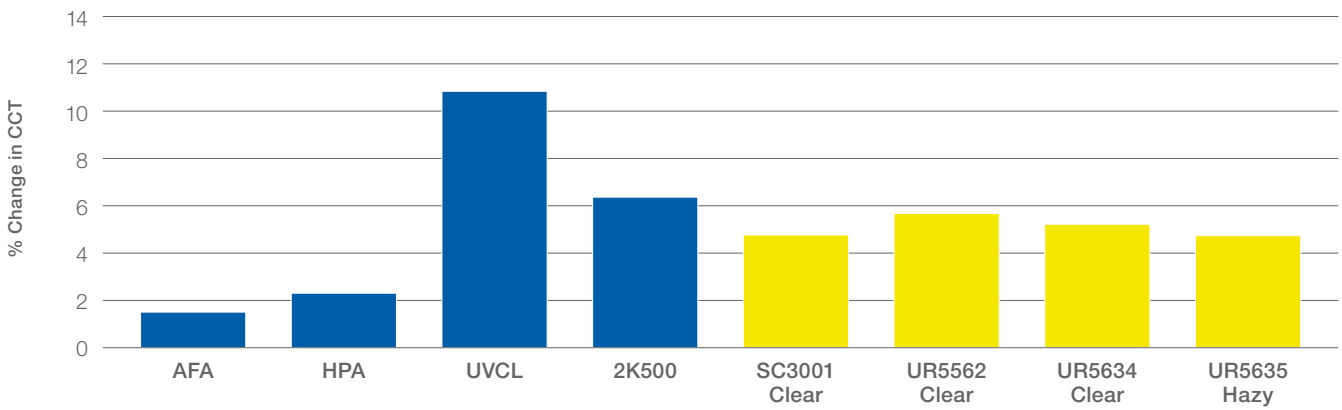
Conformal Coatings



Encapsulation Resins



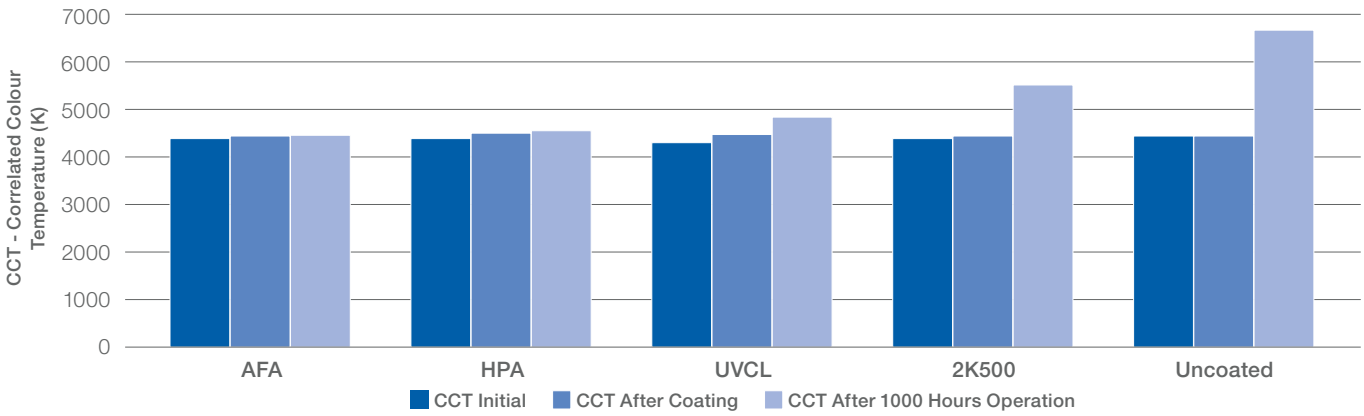
Coated/Potted LEDs



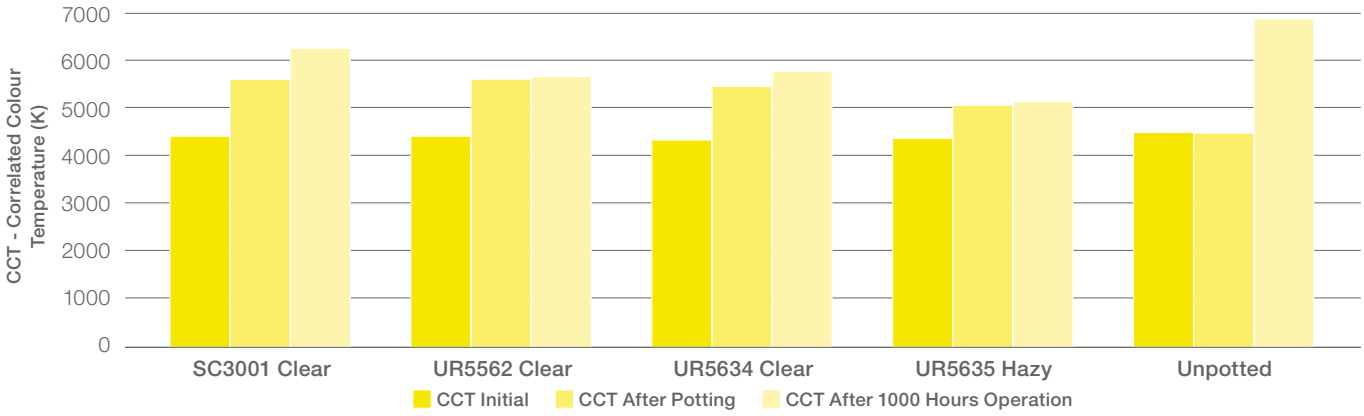
Product Tests

Correlated Colour Temperature Changes: 1000 hours Continuous LED Operation

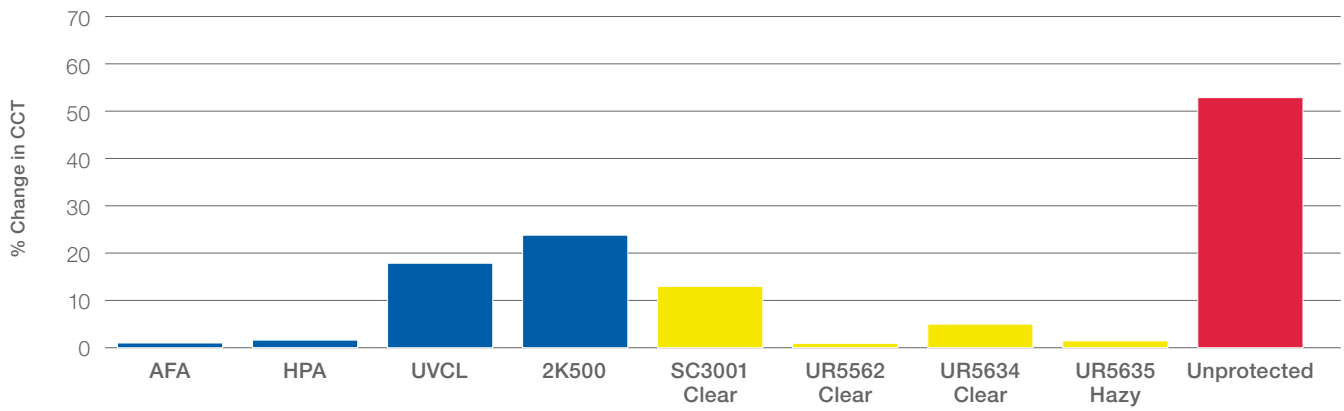
Conformal Coatings



Encapsulation Resins

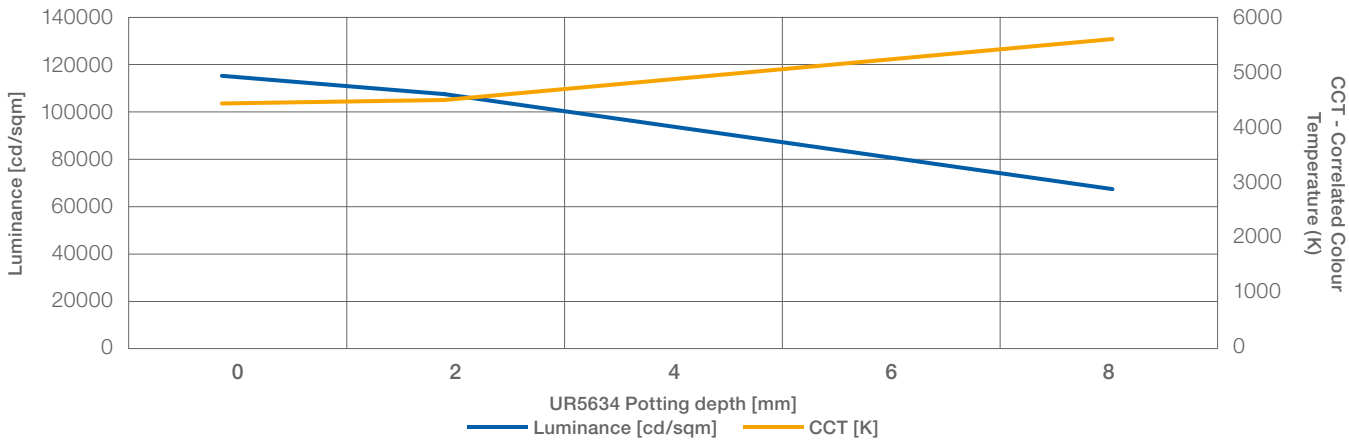


Coated/Potted LEDs

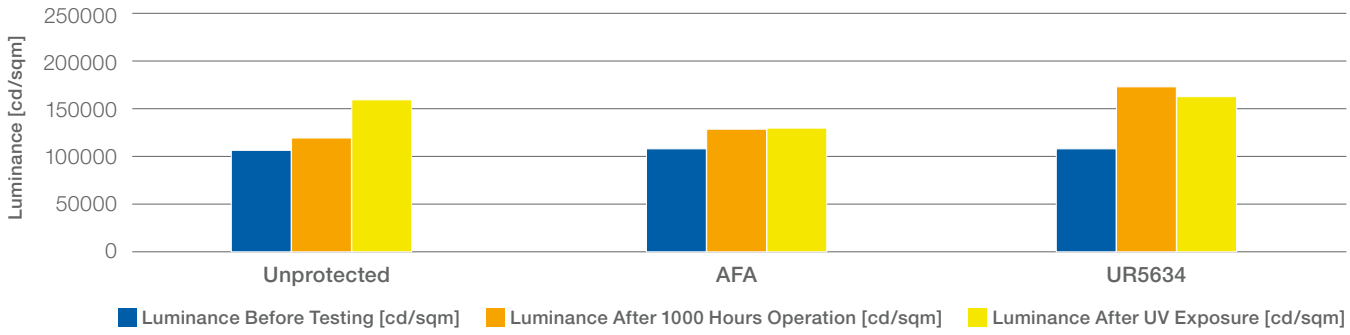


Product Tests

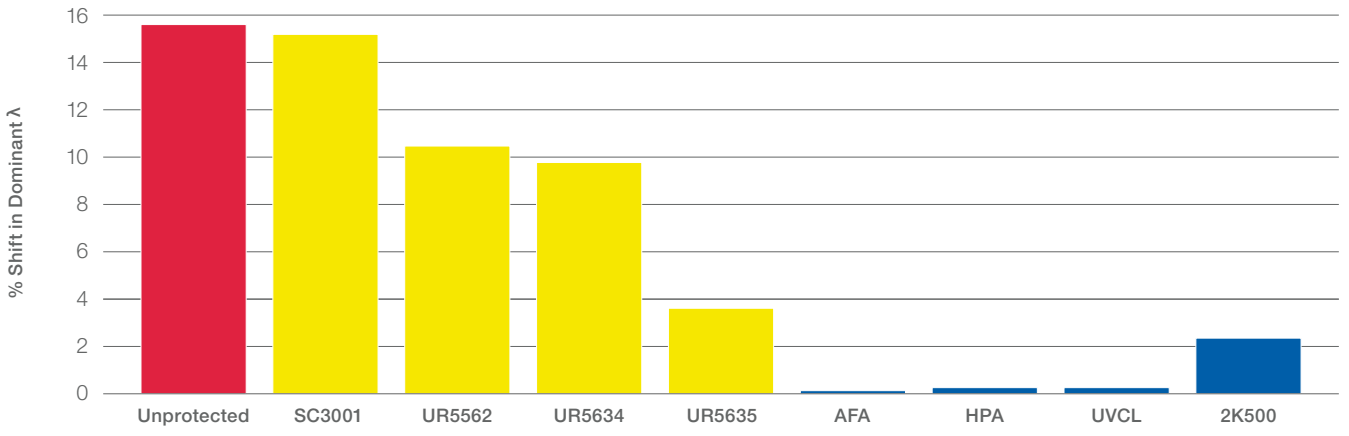
Comparison of Luminance and CCT at Different Potting Depths



Luminance Changes after 1000 hours Operation and UV Exposure



% Shift in Dominant λ after 1000 hours LED Operation



Performing When the Heat is On

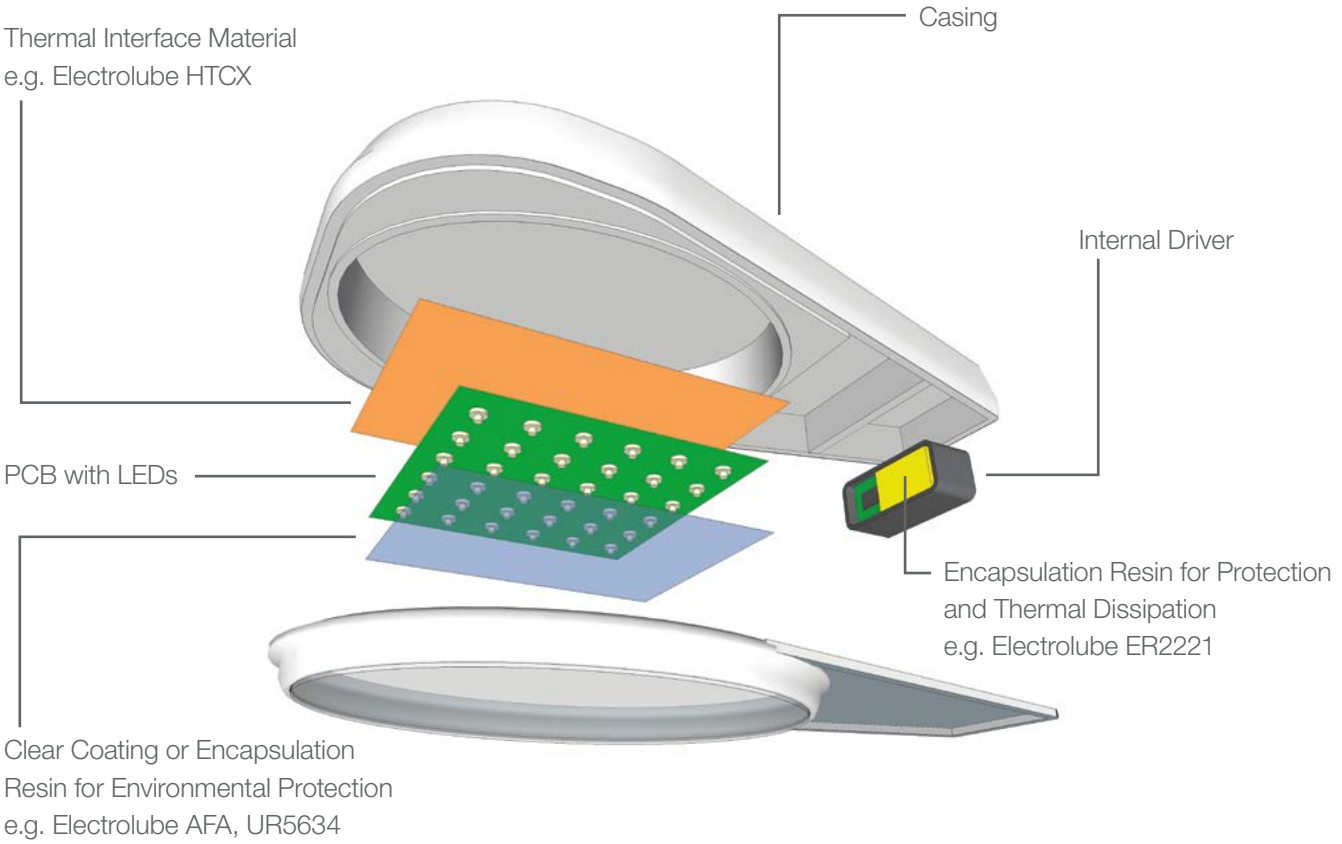
Although LEDs are considerably more efficient than traditional lighting forms, they do still produce some heat. This heat can have an adverse effect on the LED and therefore must be managed to ensure the true benefits of this technology are realised.

Electrolube can offer a range of thermally conductive products to help reduce the operating temperature of the LEDs, thus increasing the efficiency and operational lifetime.

Thermal interface materials (TIM) can be provided in both curing and non-curing forms, allowing for bonding of the surfaces or alternatively, offering heat transfer in a fully reworkable package.

In addition to thermal interface materials, Electrolube can also offer solutions for thermally conductive encapsulation for dissipating the heat away from power components such as LED drivers.

LED Street Light



Protection of LED Components

Thermal Dissipation

Power components, such as the LED driver, may also require protection from the external environment and in some cases, heat dissipation may also be required. The need for a clear material in such cases is replaced by the requirement for a robust resin with a good level of thermal conductivity.

Depending on the environment the resin will be exposed to, there is the possibility to choose between different chemistry types. For example, if the assembly will be exposed to frequent and rapid changes in temperature, a flexible polyurethane or silicone material will offer better performance than a tough, rigid epoxy.

When choosing a protective material for LED assemblies, good thermal conductivity and moisture protection should be combined with ease of processing to ensure complete encapsulation. Electrolube can assist in choosing between a number of solutions, for heat transfer at the thermal interface and for full protection via encapsulation, thus selecting the most appropriate combination of processing and in-use performance.

Removing Heat from the LED – Thermal Interface Materials

Thermal interface materials are used between the PCB and the heat sink in order to dissipate heat away from the LED, in turn reducing the junction temperature and prolonging the life of the LED.

Electrolube offer thermal bonding products as well as non-curing options, thus providing the complete solution whether the assembly is to be permanent or where the requirement for replacement of LEDs is present.

The choice of thermal interface material will also depend on the operating environment and power of the luminaire. Silicone and non-silicone options are available as well as mid-range and high thermal conductivity options.

Maximising Efficiency

The application of the thermal interface material plays a big part in maximising the efficiency of heat transfer. Electrolube's non-curing thermal management pastes can be applied in thin layers, thus dramatically reducing the thermal resistance at the interface.

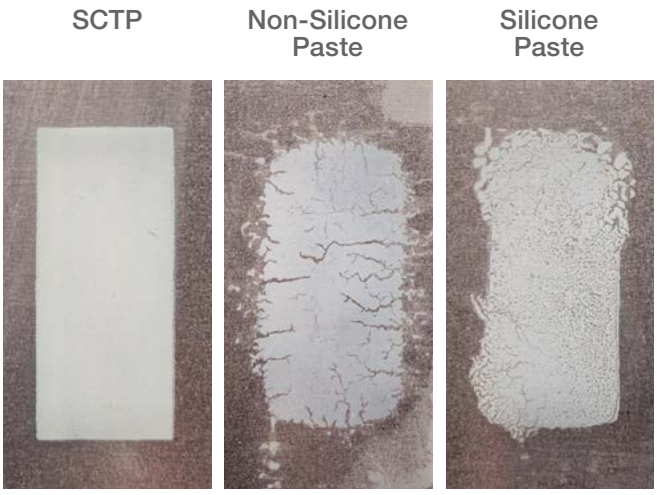
For interface materials, the viscosity of a product or the minimum thickness possible for application will have a great effect on the thermal resistance. Thus, a highly thermally conductive, high viscosity compound (that cannot be evenly spread onto the surface), may have a higher thermal resistance and lower efficiency of heat dissipation when compared to a lower viscosity product with a lower bulk thermal conductivity value.
It is essential that users address bulk thermal conductivity values, contact resistance, application thicknesses and processes in order to successfully achieve the optimum in heat transfer efficiency.

A practical example highlighting the requirement for such considerations is provided in the table below. It shows the potential differences in heat dissipation by measuring the temperature of a heat generating device in use. As the results show, the bulk thermal conductivity value does not necessarily reflect the greatest reduction in operating temperature of the device.

Product	Bulk Thermal Conductivity (W/m K)	Device Temperature (˚C)	Reduction In Temperature (˚C)
No Interface	N/A	30	N/A
SCTP	1.20	20	33%
HTC	0.90	24	20%
HTCX	1.35	21	30%
HTCPX	3.40	23	23%

Maximising Efficiency

By applying a thin, uniform layer of a thermal interface material, it is possible to obtain the maximum efficiency of heat dissipation. It is also important to consider the operating temperature conditions throughout the lifetime of the product. Frequent changes in temperature are common in LED applications with devices switched on and off regularly. This results in the unit going through a thermal cycle, heating up once switched on and cooling again when powered down. Over the lifetime of the product, many thermal cycles take place and this may affect the positioning of the thermal interface material over time. By careful consideration of the correct thermal interface material and identification of the correct test regimes, it is possible to differentiate between products and highlight the most suitable material for your application. Electrolube are available to assist with such considerations, thus allowing customers to truly maximise the efficiency of heat transfer.



Photographs illustrating the difference in performance following thermal shock testing between -40°C and +125°C.

Collaborative Testing

Electrolube work in conjunction with a number of LED manufacturers and end customers worldwide to establish the performance of our products in conjunction with different materials and environments. For example, Electrolube are proud to be a member of the Bridgelux Ecosystem Program whereby various products from Electrolube have been tested on Bridgelux products to demonstrate both compatibility and performance enhancements that are achievable. This is an ongoing program that will expand as product ranges and technologies develop further. Please contact Electrolube should you be interested in further information regarding our collaborative studies and future work.

bridgelux®

Conformal Coatings

Coating Options

Typically applied at 25-75µm, these coatings 'conform' to the contours of the board allowing for excellent protection and coverage, ultimately extending the life of the luminaire.

They are simple to apply and fast drying, thus offering the ideal combination of protection and quick throughput for high volume manufacture.

	AFA	AFA-F	AFA-S	APL	HPA	2K500
Description	Aromatic-Free Acrylic	AFA - Film Coat	AFA - Spray Coat	Acrylic Protective Lacquer	High Performance Acrylic	High Performance, Solvent - Free Urethane
Viscosity (mPa s)	175	65	45	325	300	1000
Solids Content (%)	33	20	14	35	35	100
Touch Dry Time (minutes @ 20°C)	5-10	5-10	10-15	10-15	10-15	240
Operating Temperature Range (°C)	-65 to +125	-65 to +125	-65 to +125	-55 to +125	-55 to +130	-40 to +140
Surface Insulation Resistance (Ω)	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{12}
Humidity Resistance	Excellent - Best	Excellent - Best	Excellent - Best	Good	Very Good	Excellent
UV Trace	Yes	Yes	Yes	Yes	Yes	Yes
Approvals	UL746 - UL94 V-0, (Meets) BMW GS95011-5 IPC-CC-830	UL746 - UL94 V-0, (Meets) BMW GS95011-5 IPC-CC-830	UL746 - UL94 V-0, (Meets) BMW GS95011-5 IPC-CC-830	-	MIL-I-46058C	(Meets) BMW GS95011-5 IPC CC-830

Thermal Interface Materials

Non-Curing Pastes

Thermal interface materials are used to improve the effective surface area of heat transfer. Non-curing pastes enable the application of thin films to ensure the maximum efficiency of heat transfer by keeping the thermal resistance to a minimum.

	HTCX	HTC	HTCP	HTS	HTSP	SCTP
Description	Non-Silicone Heat Transfer Compound Xtra	Non-Silicone Heat Transfer Compound	Non-Silicone Heat Transfer Compound Plus	Silicone Heat Transfer Compound	Silicone Heat Transfer Compound Plus	Surface-Cure Thermal Paste
Thermal Conductivity (W/m.K)	1.35	0.90	2.50	0.90	3.00	1.20
Viscosity (mPa s)	130,000	203,000	105,000	210,000	45,000	125,000
Operating Temperature Range (°C)	-50 to +180	-50 to +130	-50 to +130	-50 to +200	-50 to +200	-50 to +200
Evaporation Weight Loss (IP-183)	≤0.4%	≤1.0%	≤1.0%	≤0.8%	≤0.8%	≤0.8%
Volume Resistivity (Ω.cm)	10^{14}	10^{14}	10^{14}	10^{15}	10^{15}	10^{12}

Curing

Thermal interface materials that cure can be used for bonding the heat sink to the PCB/component, thus offering some structural support as well as enhancing the efficiency of heat transfer.

	TCORP	TCOR	TCER	TBS
Description	Thermally Conductive RTV Plus	Thermally Conductive Oxime RTV	Thermally Conductive Ethoxy RTV	Thermal Bonding System
Thermal Conductivity (W/m.K)	2.20	1.80	2.20	1.10
Viscosity (mPa s)	140,000	145,000	85,000	75,000
Operating Temperature Range (°C)	-50 to +230	-50 to +230	-50 to +230	-40 to +120
Cure Type	Moisture	Moisture	Moisture	2-Part
Volume Resistivity (Ω.cm)	10^{14}	10^{14}	10^{14}	10^{14}

Resins

Clear / Reflective Resins

Our encapsulation resins are complementary products to the conformal coating products, offering enhanced protection in very challenging environments.

In addition to protection from humidity, chemicals, etc. Encapsulation Resins can also offer protections against physical and thermal shock.

	UR5634	UR5635	UR5637	UR5562	SC3001
Description	Polyurethane	Polyurethane	Polyurethane	Polyurethane	Silicone
Colour	Clear	Hazy	White	Clear	Clear
Mix Ratio by Weight (by volume)	0.9:1 (1:1)	0.9:1 (1:1)	0.9:1 (1:1)	2.2:1 (2.3:1)	13:1 (12:1)
Mixed System Viscosity (mPa s)	1,050	1,050	1,050	300	1,800
Gel Time (minutes @ 23°C)	20	20	20	22	180
Cure Time (hours @ 23°C / 60°C)	24/4	24/4	24/4	24/4	24*
Shore Hardness	A80	A80	A80	A95	A20
Operating Temperature Range (°C)	-40 to +120	-40 to +120	-40 to +120	-40 to +120	-60 to +200
Volume Resistivity (Ω.cm)	10^{14}	10^{14}	10^{14}	10^{14}	10^{14}

*Cure times will be dependent on ambient humidity

Thermally Conductive Resins

Thermally conductive resins offer an enhanced protection of the luminaire from the surrounding environments as well as providing efficient heat dissipation, reducing the overall operating temperature.

	ER2183	ER2221	ER2220	UR5097	UR5633	SC2003
Description	Epoxy	Epoxy	Epoxy	Polyurethane	Polyurethane	Silicone
Thermal Conductivity (W/m.K)	1.10	1.20	1.54	0.65	1.24	0.80
Mix Ratio by Weight (Volume)	12.8:1 (5.6:1)	13.9:1 (7:1)	20.8:1 (8.2:1)	7.5:1 (6.1:1)	12.2:1 (8.8:1)	1:1 (1:1)
Mixed System Viscosity (mPa s)	5,000	3,000	15,000	6,000	30,000	30,000
Gel Time (minutes @ 23°C)	420	360	180	80	40	80
Cure Time (hours @ 23°C)	24	24	24	24	24	24
Shore Hardness	D90	D90	D90	A85	A90	A50
Operating Temperature Range (°C)	-40 to +130	-40 to +150	-40 to +130	-40 to +110	-50 to +125	-60 to +200
Volume Resistivity (Ω.cm)	10^{15}	10^{10}	10^{15}	10^{14}	10^{14}	10^{14}

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