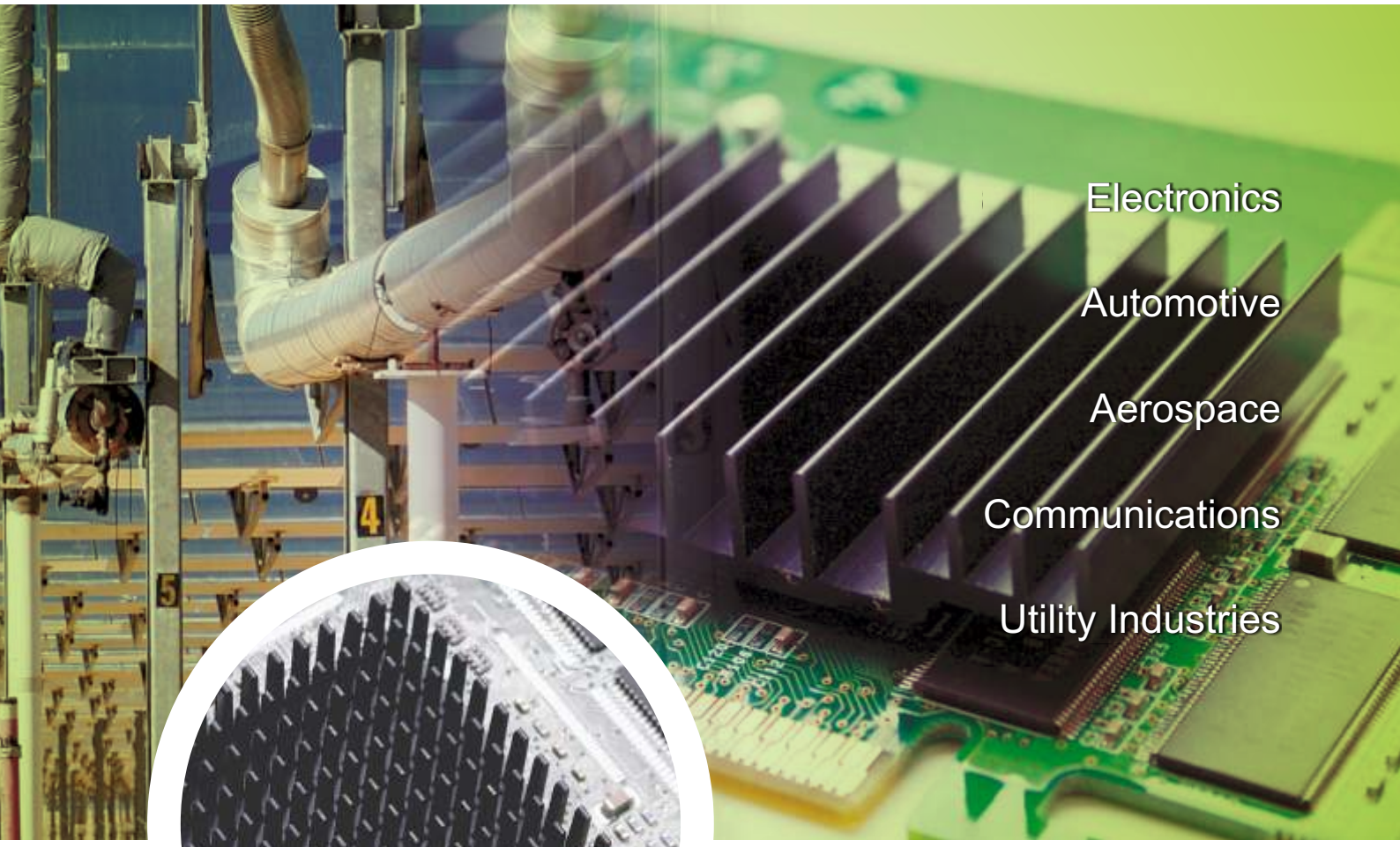
Clean, Protect, Lubricate

ELECTROLUBE



Thermal Management

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Thermal Management

- Non-silicone Pastes
- Silicone Pastes
- RTV's
- Epoxy Resins
- 0.9 to 3.4W/m.K

Most components have a maximum, effective operating temperature. Failure to maintain the temperature below this level can lead to a variation in electrical properties and overall increased failure rates.

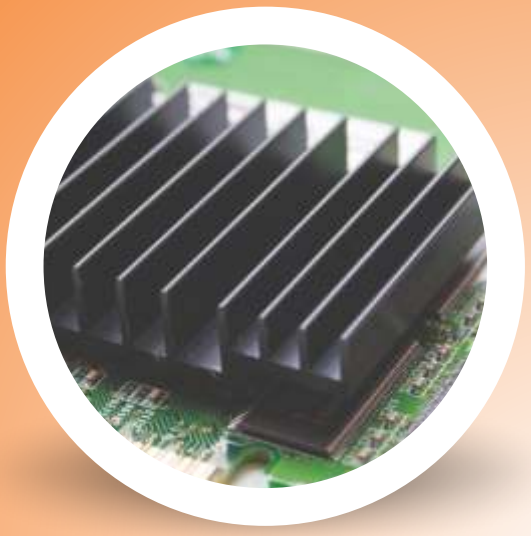
Metal heat sinks are typically connected to components which generate a large amount of thermal energy when in use. These are used to dissipate such energy away from the device to avoid failure due to over-heating.

Heat sinks have proven to be very effective over the years however in order to ensure full contact and therefore maximum efficiency, thermal management products are used alongside.

Metal surfaces, even when polished to a fine degree, have a certain amount of roughness. It can therefore be deduced that when two metal surfaces are placed together contact is not 100% and there will always be an air gap between the two surfaces.

The use of a thermal paste or adhesive allows such gaps to be filled ensuring complete contact between the two surfaces and in turn more efficient heat conductance.

The range of applications where the use of a thermally conductive material is necessary has greatly increased as electronic circuits have become more complex and powerful. These advances have resulted in greater heat generation. Solar panel systems (photovoltaics), is just one example where such heat must be drawn away from the components quickly and efficiently, ensuring long term reliability and operating efficiency.



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Thermal Pastes

Thermally conductive pastes consist of thermally conductive fillers in a carrier fluid. Thermal pastes do not cure; therefore, they offer the best solution when rework is important and provide versatility by avoiding geometrical restrictions affecting cure. The paste can be applied using a variety of methods e.g. stencil printing, screen printing or automatic dispensing equipment.

Viscosity Comparison

Product	Average Viscosity (Pa.s): 0.5mm Plate, 1 rpm, 25°C
HTC	202-225
HTCX	127-141
HTCP	101-112
HTCPX	606-670
HTS	201-227
HTSP	42-48

Silicone and silicone-free

Electrolube offers silicone (e.g. HTS) and non-silicone (e.g. HTC) thermal pastes. The silicone products can offer a higher upper temperature limit of 200˚C due to lower evaporation weight loss compared with their non-silicone counterparts. There are, however, applications where silicones may be unsuitable e.g. when devices are sensitive to silicone contamination.

Electrolube's 'Plus' Range

Electrolube's 'Plus' range (e.g. HTCP/HTSP) contain a blend of fillers in an optimised particle size combination and therefore can achieve higher thermal conductivity values than the Electrolube standard range.

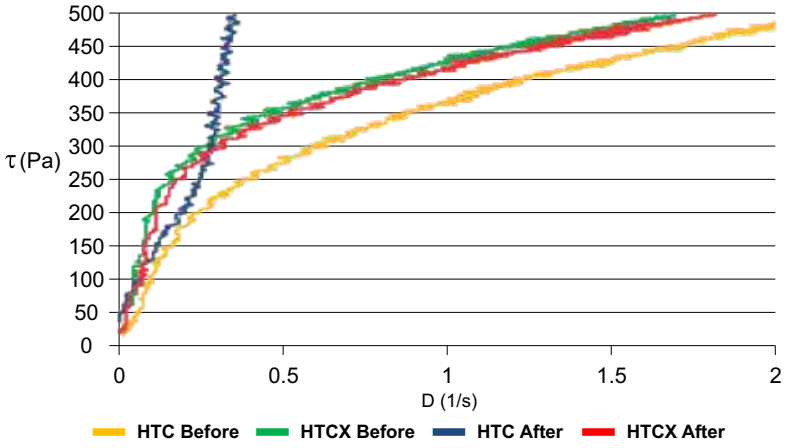
The 'Xtra' Range: HTCX and HTCPX

Electrolube's 'Xtra' range of thermal products are enhanced versions of the non-silicone products HTC and HTCP. These 'X' versions are manufactured using one of the company's proprietary technologies and possess the following benefits with almost no compromise in usability and viscosity: an increase in the comparative thermal conductivity, lower oil bleed and lower evaporation weight loss. HTCPX is mainly used as a gap filler and has been approved by one of the top manufacturers in the automotive industry.

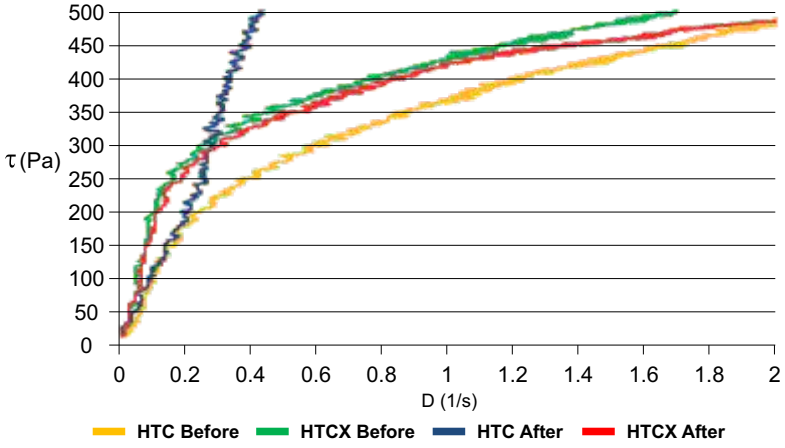
The 'Xtra' range of products are also more resistant to humidity and thermal cycling (rapid changes in heating and cooling) than the standard range.

The following graphs show the effect on humidity (168 hours, 25°C, 90% RH) and thermal cycling (25 cycles between 65°C and -25°C) on the viscosity of HTC and HTCX. The before and after results are almost identical for HTCX; however, HTC showed an increase in viscosity after the exposure.

Rheology of HTC and HTCX before and after humidity exposure



Rheology of HTC and HTCX before and after thermal cycling



Potting Compounds

For certain types of heat generating circuitry e.g power supplies, it may be beneficial to encapsulate the device in a heat-sink enclosure using a thermally conductive potting compound.

Electrolube produces a variety of two-part encapsulation solutions utilising epoxy and polyurethane technologies.

ER2074 is Electrolube's flagship thermally conductive encapsulation product. This highly-filled epoxy resin possesses high thermal conductivity (1.26 W/mK), but as a result is high in viscosity (16700 cPs).

ER2183 is a lower viscosity version of ER2074 (5000 cPs). The reduced filler content required to achieve this viscosity has little effect on the thermal conductivity performance: ER2183 is 70% lower in viscosity, but only exhibits a 13% decrease in thermal conductivity as a result (1.1 W/mK).

UR5097 is a polyurethane potting compound that possesses a similar viscosity to ER2183 (6000 cPs). This product offers very good thermal conductivity (0.65W/mK), but also has the added benefits of UL94 V-0 certification and the flexibility of a polyurethane.

Adhesive and RTV

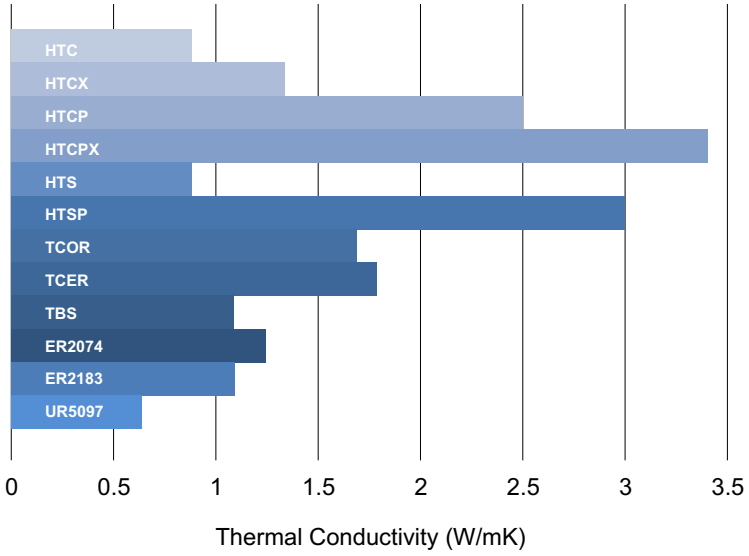
Electrolube offer a thermal bonding adhesive called TBS, as well as two RTV (room temperature vulcanising) products: TCER and TCOR.

TBS (Thermal Bonding System) is a two-part, high strength epoxy adhesive designed to bond a heat sink to the component. In addition to the mineral fillers, the adhesive contains small glass beads of controlled diameter: these allow for a set thickness of 200 microns to be achieved, providing optimal performance.

TCOR and TCER are Electrolube's silicone RTV products. TCOR is an oxime-cure RTV, and TCER is an ethanol-cure version. TCER has the advantage that it is very low in viscosity and higher in thermal conductivity compared to TCOR; however, TCOR exhibits improved bond-strength properties.

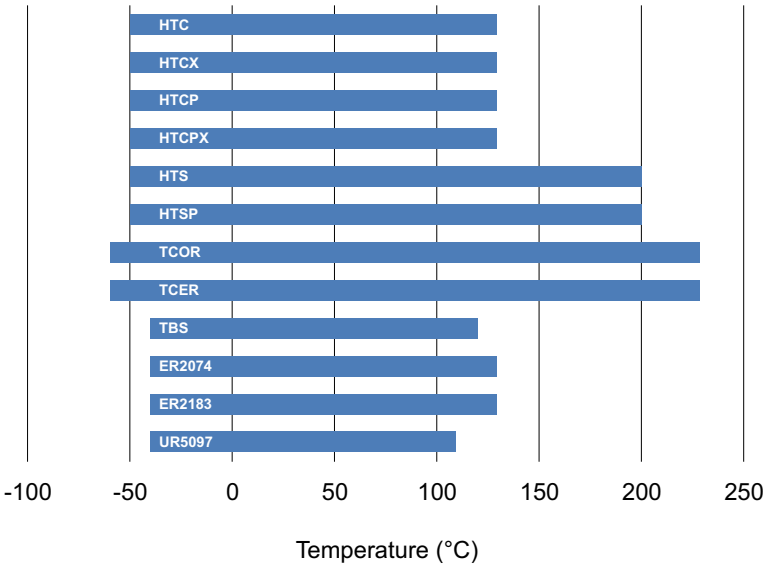
Thermal Conductivity

Some techniques only measure the sum of the material's thermal resistance and the material/instrument contact resistance. Electrolube use a version of the heat-flow method that measures both of these values separately. The following graph shows the comparative thermal conductivities of Electrolube's thermal products:



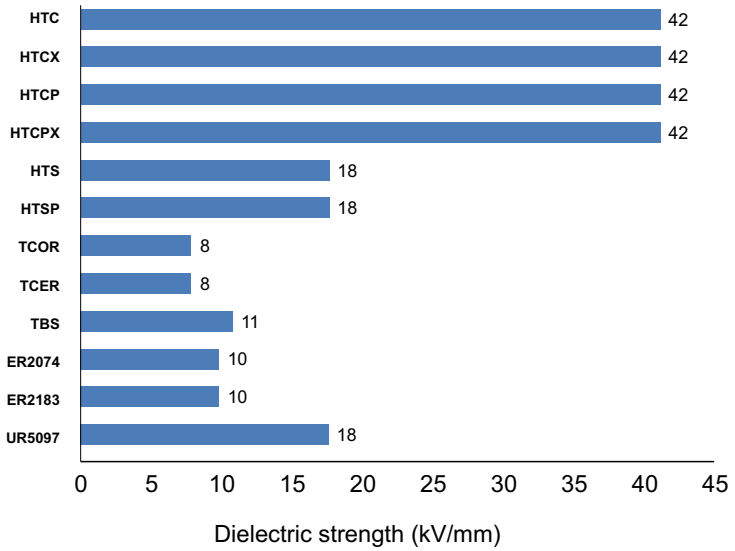
Temperature range

Electrolube's thermal management products cover an extensive operating temperature range. It is important that the temperature extremes experienced during application fall within the operating temperature range of the product selected. Depending on the type of product and chemistry chosen, the temperature range will differ. Some products may be suitable for short-term excursions outside of the recommended operating temperature ranges. Testing in representative end-use conditions is always advised.



Dielectric strength

Thermal management products are used within electrical applications and therefore must not have any detrimental effect on the performance of the device. Measurements of the electrical properties of such products can assist in proving suitability for use. For example, the dielectric strength is the maximum electric field strength that a product can withstand intrinsically without breaking down, i.e. without experiencing a failure of its electrical properties. This is sometimes also referred to as the dielectric withstanding voltage. Conversely, the breakdown voltage is the minimum voltage that causes a portion of an insulator to become electrically conductive.



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