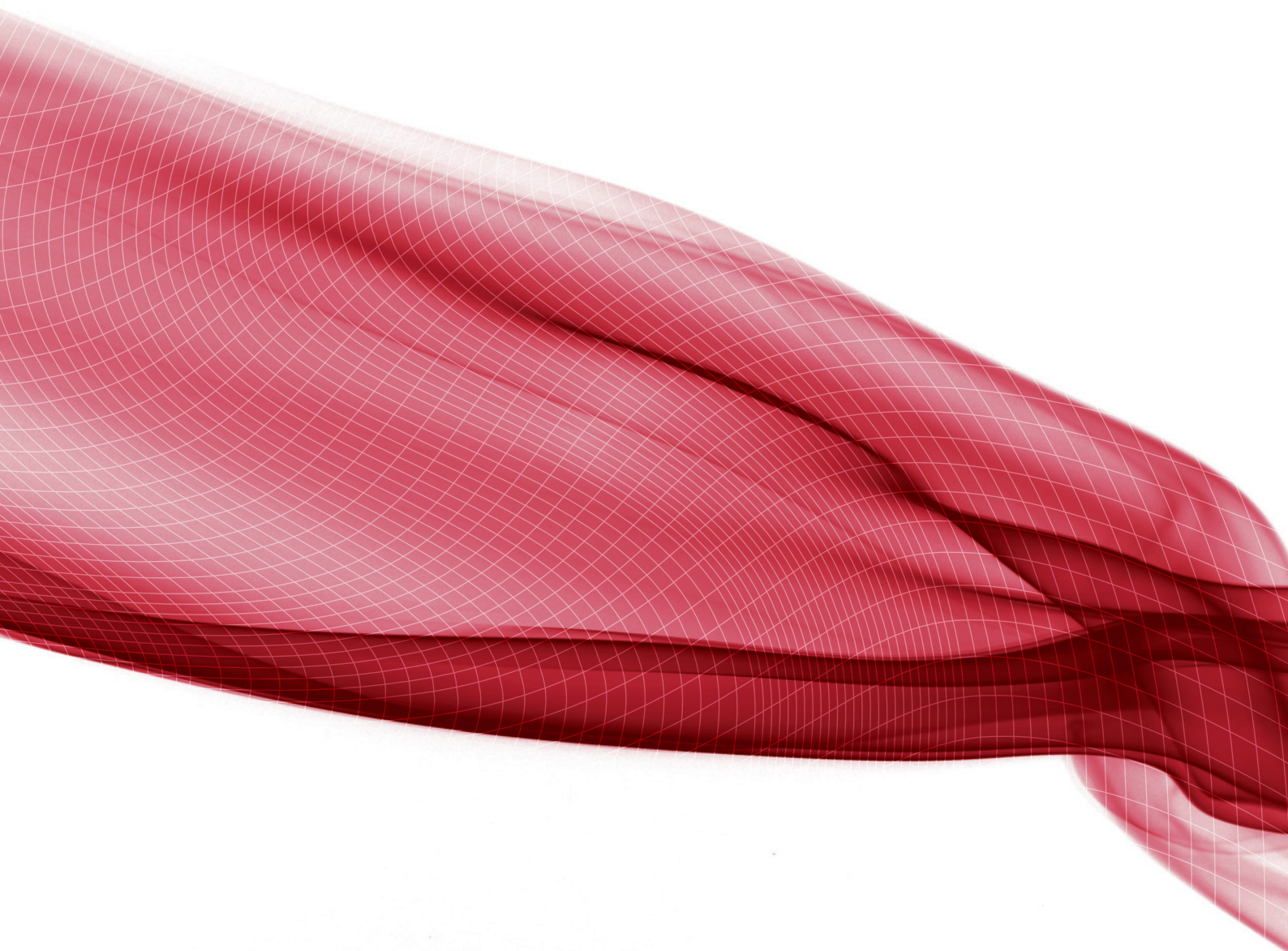


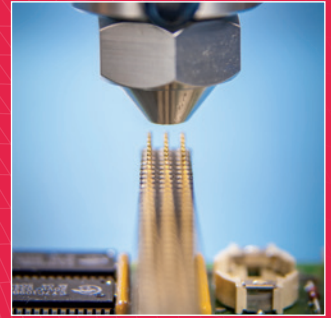
Contact Lubricants

Switch to a superior performance



ELECTROLUBE
THE SOLUTIONS PEOPLE

Contact Lubricants



- Extends the operating life of switches
- Improves signal quality
- Reduces operating temperature
- Controls switch 'feel'
- Prevents contamination
- Silicone free

Electrolube have been the leading supplier of contact lubricants since their invention by the founder in the 1950s. They increase the reliability and lifetime of current carrying metal interfaces, including switches, connectors and busbars.

Electrolube has earned an unsurpassed reputation for the manufacture and supply of specialist lubricants to the automotive, military, aerospace, industrial and domestic switch manufacturing sectors. The range has been developed over the years to accommodate many advances in such rapidly advancing industries; combining excellent electrical properties and lubricity with plastics compatibility.

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. Electrolube products are electrically insulative in thick films, preventing tracking in ultra thin films, i.e. between closed metal contacts they allow the current to flow, owing to the 'Quantum Tunnelling Effect'. They also exhibit a neutral pH thereby avoiding surface corrosion.

The effectiveness of even perfectly designed switches can be improved by contact lubricants and, when considered at the design stage, significant production cost savings can be achieved by the use of less expensive plastics and contact metals.

Tests have shown that contact lubrication can extend the lifetime of switches by more than 300%, producing excellent performance under all circumstances and preventing the need for expensive maintenance.



How Contact Lubricants Work

Contact technology is constantly developing with new alloys, plastics and customer demands. However, it is still impossible to solve the main cause of switch malfunction i.e. the inability to produce a perfectly smooth metal contact surface.

As no metal interfaces are entirely even and smooth, when applied to such surfaces in thin films contact lubricants fill in all surface imperfections, in turn improving contact and electrical performance as well as prolonging the contact life by reducing hot spots, fretting and arcing.

By filling in the air gaps between the contacts, contact lubricants dramatically increase the effective surface area, in turn preventing arcing and the related temperature rise and oxide formation. They also provide a barrier to airborne contamination and reduce the effects of friction by facilitating smooth movement. In addition, the use of contact lubricants are typically evaluated for their 'feel' characteristics, improving the quality of movement of a switch or in simple plastic/plastic contacts, for example.

Heat Generation

If there is insufficient surface contact, the current is only carried by a fraction of the 'designed surface area' and the heat generated will be concentrated at the contact points. This, in turn, causes the formation of high resistance oxide layers and 'hot spots' are observed. The overall efficiency of the switch will be reduced and can eventually lead to complete failure as the two surfaces weld together

Arcing (mini-lightning strikes)

This can also occur with un-lubricated contacts; ionisation of the air and the associated rise in temperature causes metal transfer between the contacts, resulting in new 'peaks and troughs' on the surfaces.

Mechanical Wear

Metal interfaces, whether static or moving, suffer from mechanical wear. In the case of static contacts, this is called 'fretting'; the small movements of contacts caused by vibration, temperature changes, etc. As the surfaces fret, friction causes metal particles to be removed from the peaks, breaking through plated surfaces. This exposes surface and underlying metal to the effects of oxidation and wear. Additionally the detached metal particles can cause intermittent signal transmission and ultimately switch failure.

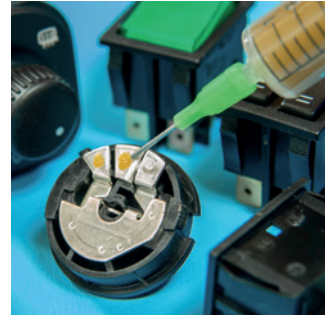
Silicone Contamination

As silicones can "creep" great distances, these products should not be used in switch assembly areas. When silicone is present between moving or vibrating contacts, they react under arcing conditions to form silicon carbide. These crystals abrade the contact surface and cause electrical breakdown. Electrolube contact lubricants also eliminate the problems associated with silicone contamination, providing they are applied prior to the introduction of silicone.

Switch Operation

The way a switch 'feels' when operated has become an indicator of quality, particularly within the automotive industry. Contact lubricants, in addition to their technical benefits, can also determine the 'feel' of a switch, whether it be strong and decisive for the dashboard of a commercial vehicle, or smooth and quiet for a luxury car.

Automotive Applications



Electrolube's automotive lubricant product range helps engineers meet the huge demands they face on a daily basis. Design engineers are under pressure to keep costs down by the correct selection of materials for complex, innovative designs.

The development of Electrolube's lubricants, together with leading automotive manufacturers, has led to materials with enhanced performance across wide temperature ranges, improved resistance to the external environment and overall development of the electrical and mechanical properties of these materials. In addition, Electrolube lubricants are compatible with the most sensitive of plastics and are continually reviewed to meet the latest regulatory requirements.

Dual Purpose Lubrication

The most important role of lubricating greases is to protect from wear and corrosion. Damping lubricants are materials which ergonomically control free motion and noise in mechanical components whilst giving a "quality feel" to hand operated mechanisms. For current carrying metal interfaces, the major advantage is that they increase the reliability and lifetime of these components by preventing corrosion and wear, which could include sensors, switches, potentiometers and connectors, for example.

The following information covers each of these applications in more detail and provides some starting suggestions for choice of lubricants. Technical data sheets can be referred to for additional information on each product and in all applications the lubricant must be fully tested in representative end-use conditions to confirm correct selection.

Connectors

Contact lubricants are used extensively for connectors. Connectors in early automotive applications were plagued with "fretting corrosion" problems. Although tin and silver plated contacts are more commonly used, gold plated contacts are also apparent in some connector designs. Gold is a soft material and can exaggerate fretting corrosion.

A lubricated switch is subject to far less mechanical wear as the lubricant facilitates smooth movement. Friction and wear are therefore greatly reduced, extending switch lifetime, improving electrical efficiency and allowing the use of a wider selection of materials.

Such improvements are extremely important in the challenge of meeting the energy efficiency requirements of today's more fuel economical and hybrid/electric vehicles.

Example Applications

| | |
|---|-----------------|
| Gold Plated Contacts/Air-Bag Connectors | CG60/SOK |
| High Insertion Force Applications | EGF |
| Slip Ring Devices | SOB/CO70 |

Switches and Contacts



High Current Arcing Switches or Contacts

As un-lubricated contacts open and close, arcing (mini lightning strikes) can often occur. Ionisation of the air and the associated rise in temperature causes metal transfer between the contacts, resulting in the formation of new 'peaks and troughs' – a common problem found in high power contacts. The problem of arcing is also compounded in 'make and break' switches, where every time the circuit is opened, the contacts may bounce several times before finally mating. This exacerbates the problems discussed previously and subjects the circuit to repeated surges of current giving a poor signal to noise ratio.

This problem is not found in lubricated switches, as the lubricant fills the air gap between the contacts, preventing arcing, related temperature rises and corrosive chemical formation; as air is excluded from the metal surfaces, airborne contamination cannot form insulative barriers on the metals. Finally, contact lubricants provide a cushion between the contacts to dampen the effects of bouncing.

Example Applications

| | |
|-------------------------|----------|
| Starters/Ignition | CG53A |
| Heating and Ventilation | CG71/SOK |

Medium Current Switches or Contacts

These types of switches vary in design parameters and materials usually employed. Typically more sensitive plastics and elastomers are used and therefore compatibility with all lubricant materials must be tested.

In such applications lubricants are used to dramatically increase the effective surface area of the contact, thus eliminating hot spots, improving efficiency and ensuring that contact resistance remains low and stable.

Example Applications

| | |
|------------------------------|--------------|
| Windscreen Wipers | CG71 |
| Central Locking Switches | CG60/CG71 |
| Power Seat Switches | CG60/CTG/EGF |
| Dashboard Control Mechanisms | CG70 |
| Power Window Switches | CG70/CG53A |
| Micro Switches | EML/CO70/SON |

Low Current Carrying Switches and Contacts

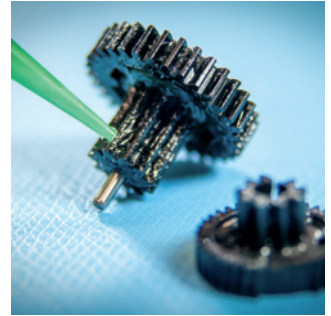
Low current carrying switches and contacts are typically made with the most sensitive plastic and elastomer rubbers, yet being low current carrying, demand the best electrical performance from contact lubricants.

Electrolube's contact lubricants have been used extensively for high quality audio applications and ergonomic controls. The application of lubricants prevents corrosion of the metal interfaces, whilst providing the switch with low levels of electrical noise and a very stable signal.

Example Applications

| | |
|-------------------------------|--------------|
| Steering Wheel Switches | CG71 |
| Light Switches | LCG |
| Low Contact Pressure Switches | SOA/CO70/SGN |
| Audio Switches | CG71/LCG |

Sensors and Non-Electrical



Sensors and Potentiometers

Potentiometers have low contact forces and must stay in contact with the resistor; a high viscosity grease would not allow close contact with the resistor, therefore the most suitable materials are constructed from low viscosity base oils, coupled with an effective, non-carbonising thickener.

As well as functioning at very high temperatures, fluorinated lubricants have exceptional plastics compatibility and solvent resistance and are therefore ideal for fuel level sensors, particularly in oil form where a thin, uniform application of a long lasting lubricant can be applied to the surface.

Example Applications

Fuel Level Sensors
 Seat Position
 Electronic Throttle

EOF/DOF
 EGF/CG60
 EGF/EOF

Interior Components – Non Electrical

Interior components requiring lubrication come in many combinations:

- Metal-metal contacts – seating tracks, sunroof tracks, etc.
- Plastic-plastic contacts – windscreen wiper gears, window visor, cup holders, grip handles, etc.
- Plastic-metal contacts – cables, glove compartment locking mechanisms, etc.

Each application requires a certain grease characteristic to provide damping of free movement and noise as well as providing a quality feel. Electrolube's damping lubricants offer engineers an economical route to quality.

Example Applications

Medium-Heavy Viscosity:

| | |
|------------------------|---------|
| Dashboard Needle Gauge | SPG/SCO |
| Window Visor | SPGA |
| Window Tracks | CTG/SGN |

Light Viscosity:

| | |
|-------------------------------------|---------|
| Cup Holders, Ashtrays, Grip Handles | SPG |
| Ventilation Air Flaps | SPG/SCO |
| Sunroof Mechanisms | SPG/SGN |
| Mirror Adjustments | SPG/SCO |

Product Selection

Plastics Compatibility



It is important to discuss the options available at the design stage to ensure correct product selection and application. Many factors must be considered when choosing a contact lubricant, among the areas to be considered are; voltage, current, operating temperature range, environmental conditions, contact metals, number of cycles and associated plastics.

Plastic test bars were coated in various Electrolube lubricants and placed on a test rig under strain. The samples were then conditioned for 7 days at 40°C before inspection

Key

1. Fail – snapped
2. Severe stress cracking but not snapped
3. Stress cracking seen
4. Pass – some very slight stress cracking
5. Pass – no incompatibility seen

| Plastic Grade | EGF | CTG | SPG | CG60 | CG70 | CG71 | SGB | SGA |
|--|-----|-----|-----|------|------|------|-----|-----|
| PC + PBT/PET – Makroblend DP 7665/MBS162 | 5 | 5 | 5 | 5 | 5 | 1 | 5 | 1 |
| PC + PBT/PET – Makroblend KU27915 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 |
| PC + PBT/PET – Makroblend S7916 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 |
| PC – Makroblend 2407 | 5 | 5 | 5 | 3 | 1 | 2 | 1 | 1 |
| PC + ABS – Bayblend T45 | 5 | 5 | 5 | 5 | 5 | 1 | 1 | 1 |
| PC + ABS – Bayblend T8SXF | 5 | 5 | 5 | 4 | 1 | 4 | 1 | 1 |
| PBT – Ultradur B4300G6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PBT – Ultradur B4520 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| PA – Ultramid B3WG6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| PA – Ultramid A3WG6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PA – Ultramid B35 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PA – Ultramid A3K | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PBT – Crastin CR SK605 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PBT – Crastin CRS620F20 NC10 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| PP – 3150 – MX5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 |
| PP – 3060 – MW5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| PP – 3120 – MU5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

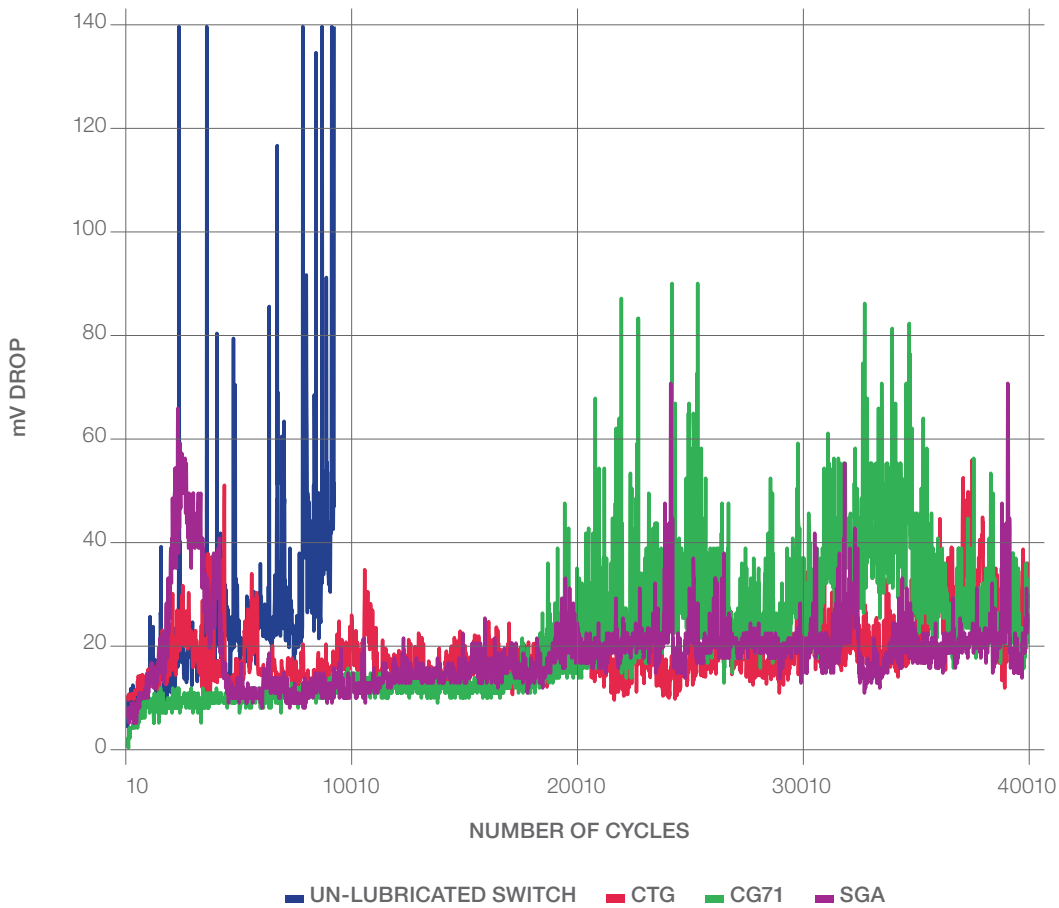
ABS = Acrylonitrile butadiene styrene PA = Polyamide PBT = Polybutylene terephthalate PC = Polycarbonate
 PET = Polyethylene terephthalate PP = Polypropylene



Electrical Testing

Electrolube have a custom built switch rig for the lifetime testing of contact lubricants. Every product is subjected to this test, using a standard automotive switch for comparison purposes.

The results provide a measurement of mV drop over the cycling period and show how the use of contact lubricants can dramatically increase switch performance and lifetime.

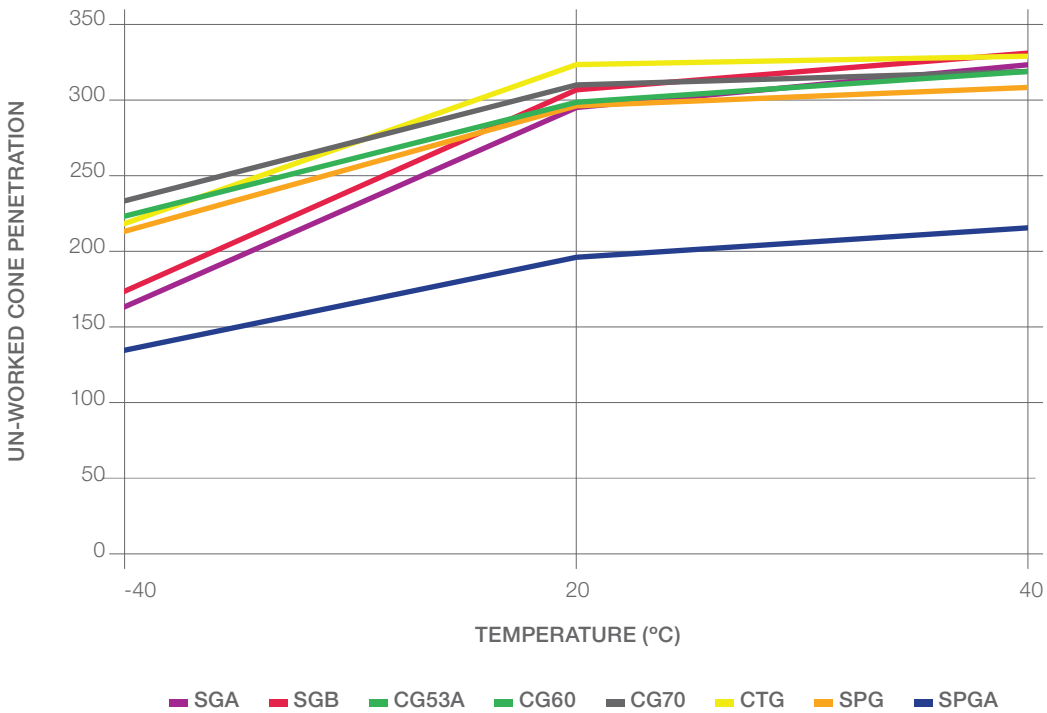


Cone Penetrations



To establish the consistency and possible variations in performance at a range of temperatures, the cone penetration values were measured according to ASTM D217.

The un-worked cone penetrations of various Electrolube contact lubricants were tested at -40°C, 20°C and 40°C:





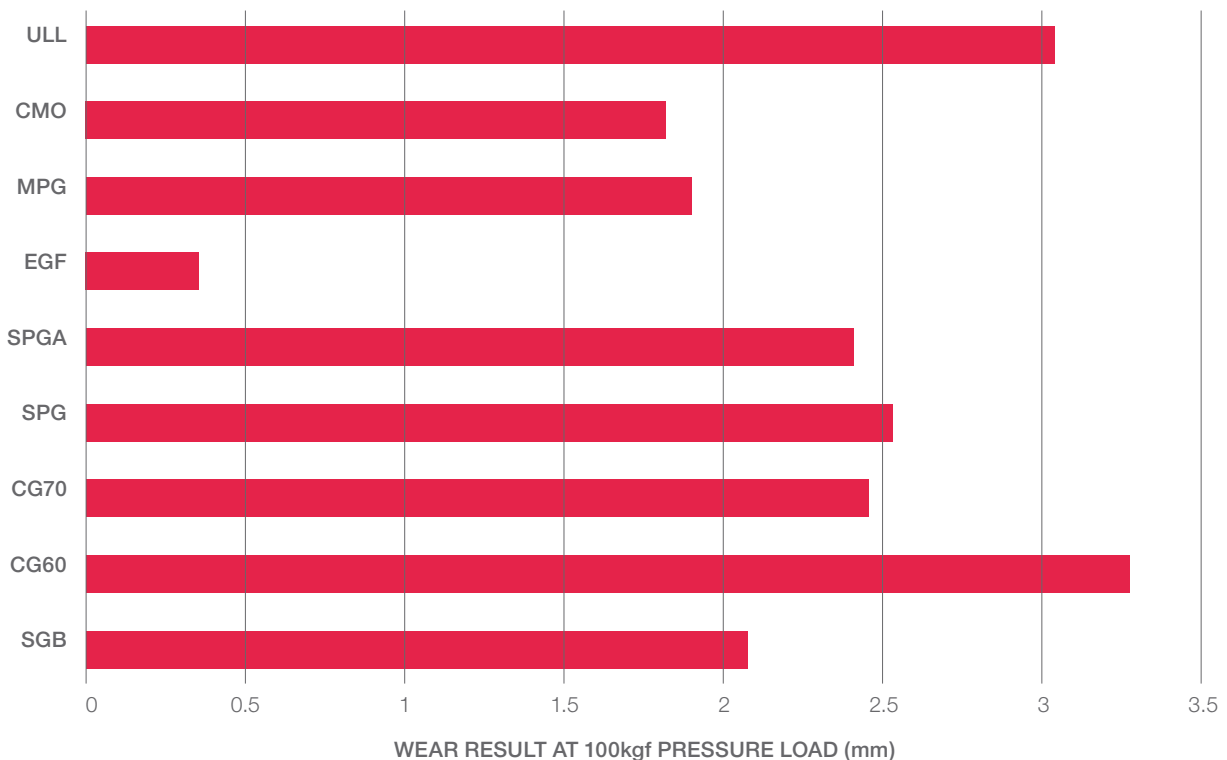
Mechanical Testing

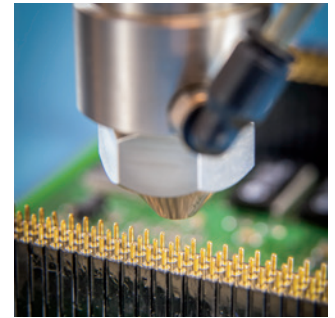
To establish the mechanical performance of the various contact lubricants, 4-ball wear testing was completed to ASTM D 2596/87. Included in this testing were some lubricants from the general maintenance range where the end application is more mechanical lubrication than electrical contact improvement.

The test consists of loading the grease into equipment that has four balls under a defined rotation. A pressure load is introduced onto the balls and the load increased according to a logarithm function.

The results are given as a pass value and a wearing value at the pass value. The wearing value is measured in mm and quantifies the amount of wear observed on the balls utilised in the test.

The weld point is the end of the test where the wearing of the balls was more than 4mm (the maximum according to the methodology). This value is usually only used for indication, the pass and wearing values are the most important for selection purposes.





Protection in Humid / Corrosive Environments

A test schedule was constructed in order to establish which products provide the highest level of protection in high humidity and corrosive environments.

Steel and copper panels were coated in a variety of Electrolube contact and mechanical lubricant products and subjected to 90% humidity at 35°C for 3 weeks, followed by 1 week in the salt spray chamber, utilising a 5% salt solution at 35°C.

The conditioned panels were visually inspected and the % corrosion/oxidation present was recorded.

| 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.

Protection of Gold and Silver Contacts

The protection of gold and silver contacts is also very important. A range of gold and silver plated contacts were coated with various contact and mechanical lubricants and placed into the salt spray chamber for 7 days. The settings were 5% salt solution, 35°C.

The majority of the Electrolube products performed exceptionally well as the gold and silver plated contacts showed no signs of corrosion following the test.

The following products provided a very high level of protection for the gold and silver plated contacts; EGF, E3C-CA, CG60, CG70, CG71, CG53A, CTG, SGB.

The only product to show signs of corrosion on the gold and silver plated contacts was MPG. This product is therefore not advised for use on gold and silver surfaces, particularly where high levels of humidity or salt spray are present.

Chlorine Resistance

This test was devised to determine which contact lubricant products provide the best protection against oxidative environments. Copper panels were coated in various contact and mechanical lubricants and subjected to 2 months at 35°C in an oxidative atmosphere containing chlorine.

The results showed that E3C-CA gave the best protection, followed by CG53A, CG60, CG70 and CTG.

The Product Range



CG60 – Contact Grease

- Excellent high performance lubricant
- Reduces electrical background noise
- Excellent plastics compatibility
- Contains a UV trace to allow easy inspection



SGA – Special Contact Grease

- Effective treatment for all types of contacts
- Reduces contact resistance and arcing of contacts from small relays to high capacity contactors
- Will not migrate from vertical contacts or surfaces
- Oil version available (SOA)



CG70 – Contact Grease

- Exceptional performance at low temperatures
- Very good plastics compatibility
- Good electrical performance
- Oil version available (CO70)



SGB – 2GX Contact Treatment Grease

- High quality, non-melting contact grease
- Hard consistency version (SGBH) and oil version (SOB) available
- Reduces contact wear and arcing
- Good plastics compatibility



CG71 – Contact Grease

- Enhanced electrical properties, gives a consistently low mV drop
- High level of oxidation stability
- Low wear characteristics
- Good plastics compatibility



SOK – 8X Contact Treatment Oil

- Contact oil for switch applications
- Non-flammable and silicone free
- Excellent electrical properties
- Reduces arcing and hence contact wear



CG80 – Contact Grease

- Excellent performance at high temperatures
- Good electrical properties
- Low evaporation weight loss
- Contains a UV trace to allow easy inspection



SON – 10X Contact Treatment Oil

- Extremely effective at low operating temperatures
- Low viscosity oil
- Grease version (SGN) available
- Ideal for low contact pressure applications such as micro switches



CG52B – Contact Grease

- Reduces contact resistance
- Suitable for both moving and static contacts of all metal types
- Developed initially for the automotive industry
- Successful connector lubricant



CTG – Contact Treatment Grease

- Excellent protection in corrosive environments
- Wide operating temperature range
- Good electrical performance
- Excellent plastics compatibility



CG53A – Contact Grease

- Excellent electrical properties
- Good plastics compatibility
- Superior protection in harsh environments
- Wide operating temperature range



EGF – Eltinert F Grease

- Excellent chemical resistance
- Exceptionally wide operating temperature range
- Prevents and cures high contact resistance caused by silicone contamination
- Oil version (EOF) and dilute oil version (DOF) available



SPG – Special Plastic Grease

- Synthetic grease offering outstanding low temperature performance
- Excellent compatibility with thermoplastics, including ABS and Polycarbonate
- Effective lubrication of plastic-to-plastic and plastic-to-metal contact surfaces
- More adhesive version available (SPGA)



E3C-CA – Electrolytic Cell Connection Compound

- For use on connections and switches in electrolytic, electro-plating and anodising plants
- Reduces temperature at contact surfaces
- Improves plant productivity and reliability, thus reducing maintenance costs
- Superior corrosion protection and oxidation stability



EML – Contact Cleaner Lubricant

- Cleans and lubricates switches, connectors and slip rings
- Removes dirt and protects from further contamination
- Reduces contact resistance
- Commonly known as switch cleaner



EPC – Electro-Plating Compound

- Especially developed for use on electro-plating and anodising plants
- Inhibits against corrosion
- Improves electrical contact on anode and cathode bars, pick-up shoes, rack contacts, busbar joints etc.
- Formulated to assist in the removal of tarnish and corrosion



SWC – Non-Flammable Switch Cleaner Lubricant

- Provides protection against arcing and corrosion
- Non-flammable, can be used on live equipment
- Safe to use on most plastics
- Contains high quality contact treatment oil



CCS – Contact Cleaning Strips

- Easy to use
- Impregnated, mildly abrasive card
- Cleans, refurbishes and lubricates metal contacts
- High quality contact lubricant



ULL – Ultralube

- Tenacious long lasting and non-staining lubricant
- Ideal for use on printer mechanisms
- Can be used as an edge connector lubricant, particularly for gold contacts
- Can be used as a silicone inhibit for relays

*Various sizes are available for most products, including bulk.

Contact Lubricants

| | SGA | SGB | CG53A | CG60 | CG70 | CG80 | EGF | SPG | CTG |
|--|-------------|-----------------|--------------|------------------------|-----------------------------|------------------------------|------------------|--------------------------------|---------------------|
| <i>Specialist Property</i> | Low mV Drop | General Purpose | High Voltage | Plastics Compatibility | Low Temperature Performance | High Temperature Performance | High Temperature | Plastic Mechanical Lubrication | Moisture Resistance |
| Pour Point (base oil, °C IP-15) | -54 | -37 | -37 | -54 | -70 | -35 | -25 | -57 | -62 |
| % Evaporation Weight Loss (IP-183 100°C) | 0.90 | 0.93 | 0.21 | 0.30 | 0.30 | 0.20 | <0.10 | 0.20 | 0.30 |
| Drop Point (°C IP-31) | >250 | 250 | 200 | 200 | 200 | 200 | >250 | >250 | >200 |
| Penetration (Worked, Cone, 20°C IP-50) | 320 | 320 | 320 | 320 | 320 | 320 | 280 | 320 | 330 |
| Temperature Range (°C) | -40 to +125 | -35 to +130 | -35 to +130 | -45 to +130 | -55 to +130 | -30 to +160 | -25 to +300 | -40 to +125 | -50 to +160 |
| Mechanical Lubrication | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ |
| Electrical Performance | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ |
| Humidity Resistance* | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ |
| Plastics Compatibility** | No | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ | ★★★★★ |
| UV Trace | No | No | No | Yes | Yes | Yes | No | No | No |
| Oil Version Available | SOA | SOB/ EML | No | No | CO70 | No | EOF/ DOF | No | No |

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

Every solution is within our spectrum

**Polyurethane
& epoxy resins**

**Contact
lubricants**

**Thermal
management
solutions**

**Maintenance
& service aids**

**Water and
solvent
based
cleaning**

**Conformal
coatings**

In the formulation, manufacture and supply of conformal coatings, thermal pastes, encapsulants, cleaners and lubricants, we have the solution. Through collaboration and research, we're developing new, environmentally friendly products for many of the world's best known industrial and domestic manufacturers – always to ISO standards.

Combine this unique ability to offer the complete solution with our global presence and you have a more reliable supply chain and a security of scale that ensures you receive an exemplary service.

Want to know more about this successful formula? Simply call, or visit our website.



+44 (0)1530 419600
www.electrolube.com

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China Headquarters / Manufacturing

Building No2, Mauhwa Industrial Park,
Caida 3rd Street, Caiyuan Industrial Zone,
Nancai Township, Shunyi District
Beijing, 101300
Peoples Republic of China

T +86 (10) 89475123
F +86 (10) 89475123
E info@electrolube.co.uk

www.electrolube.com

UK Headquarters / Manufacturing

Ashby Park
Coalfield Way
Ashby de la Zouch
Leicestershire
LE65 1JR
United Kingdom

T +44 (0)1530 419600
F +44 (0)1530 416640
E info@electrolube.co.uk

www.electrolube.com

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