Enhancing the Performance of Connectors and Switches with Contact Lubricants

Jade Bridges
European Technical Support Specialist – Electrolube Ltd

Introduction to Contact Lubricants

Contact lubricants are specially formulated greases and oils, designed to reduce friction and wear and enhance electrical performance of current carrying metal interfaces, such as those found in switches and connectors. Contact lubricants are typically electrically insulative in thick films but in ultra thin films they allow the current to flow. As no metal interfaces are entirely even and smooth, when applied to such surfaces in thin films they 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.

Product Selection

Contact lubricants can extend the lifetime of switches by more than 300%, enhancing performance in a variety of applications and preventing the need for expensive maintenance. So, how can you ensure correct product selection?

There are many practical considerations that first must be taken into account. In typical switch applications, one of the most common factors to consider is whether there are any plastics surrounding the contact area. Plastics compatibility can vary depending on the type of plastic and lubricant being used. More sensitive plastics, such as polycarbonate, require a specialist lubricant formulated using synthetic base oils, such as Electrolube’s CG60. In the case of less sensitive plastics,
such as polyamide, mineral oil based lubricants may be suitable and in some cases can provide enhanced electrical performance.

Electrical performance is evaluated by measuring the mV drop of the contacts/switches over a specified number of cycles. This is usually in excess of 20,000 usage cycles. The performance of various contact lubricants can vary depending on the formulation and intended end use. For example, some materials have a more stable low mV drop over a large number of cycles but compromise on their plastics compatibility, as shown in Figure 1. It is therefore important to consider all electrical requirements, material compatibility and environmental influences when choosing the correct lubricant.

![CG60 vs. CG71 mV Drop Comparison](image)

**Figure 1 – Comparison of CG60 and CG71 – Electrical Performance and Plastics Compatibility**

Environmental influences can include temperature changes, humidity exposure and corrosive atmospheres. Changes in temperature can affect the consistency of the contact lubricant, for example, a lubricant may have a cone penetration value of 320 at 25°C but when exposed to temperatures of -40°C or lower, this value may significantly reduce meaning that the lubricant stiffens. This change can result in a reduction in performance, particularly in terms of reducing friction. Temperature changes can also result in a difference in compatibility of materials, for example, at higher temperatures the plastics compatibility may be reduced. It is therefore vital that the operating temperature range of the connector or switch is compared to the operating temperature range of the lubricant and ‘in use’ tests are performed.
Going Beyond Simple Switch Applications

Humid environments are common and most contact lubricants will withstand high humidity for prolonged periods. When high humidity is combined with corrosive environments, differences between products can be realised. Electrolube have designed a series of tests to illustrate these differences and provide further assistance with correct product selection. These tests include wetting humidity followed by salt mist tests, chlorine resistance tests and consideration of different contact materials.

The combined humidity and salt mist testing subjected the lubricants to 90% humidity at 35°C for 3 weeks, followed by 1 week at 35°C in the salt mist chamber. The protection of copper and steel substrates was visually evaluated after this test. Typically, the synthetic lubricants, such as Electrolube CG53A provided the best protection in this environment. In addition to this test, gold and silver contacts protected with various lubricants were also subjected to the salt mist environment. Results further strengthened previous findings, highlighting that some mineral based lubricants in particular are not suitable for protecting these materials in harsh environments. Finally, as an extreme test, an oxidative environment containing chlorine was created and maintained at 35°C for 2 months and results again showed that Electrolube CG53A provided exceptional protection, closely followed by Electrolube CG60 and CG70.

In addition to considering environmental effects, Electrolube have evaluated the mechanical performance of their lubricants by conducting 4-ball wear tests. The test consists of loading the grease into specialist equipment that has four balls under a defined rotation and pressure loads are applied. The values taken are the 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 test balls. The weld point is also determined as the point where the wearing is in excess of 4mm. These tests clearly illustrated that the fluorinated materials offer superior mechanical protection. Lubricants such as Electrolube EGF far surpassed standard synthetic and mineral based lubricants, typically using lithium and clay based thickeners. Figure 2, highlights the differences between these materials.
Summary Points

This article has highlighted the requirement for contact lubricants and the numerous benefits they bring to switch/connector applications in a variety of industries. It has gone on to discuss the practical considerations needed when choosing the correct lubricant; these include but are not limited to, plastics compatibility, temperature range and electrical performance. Moving on from these basic requirements it is essential that the final application environment is considered in detail as the added stress of corrosive environments or mechanical wear can greatly alter the product selection stage. It is vital that no matter what the application or the lubricants used previously, testing must take place. Whether it is a change in component material or an alteration to the environment or electrical requirements, many factors can alter the performance of a switch or connector. With over 60 years of experience in contact lubricants and a diverse customer base in the automotive, military and domestic appliance industries, Electrolube are fully committed to providing the highest level of customer support both in terms of product selection and new product development, thus enhancing switch performance for the future.