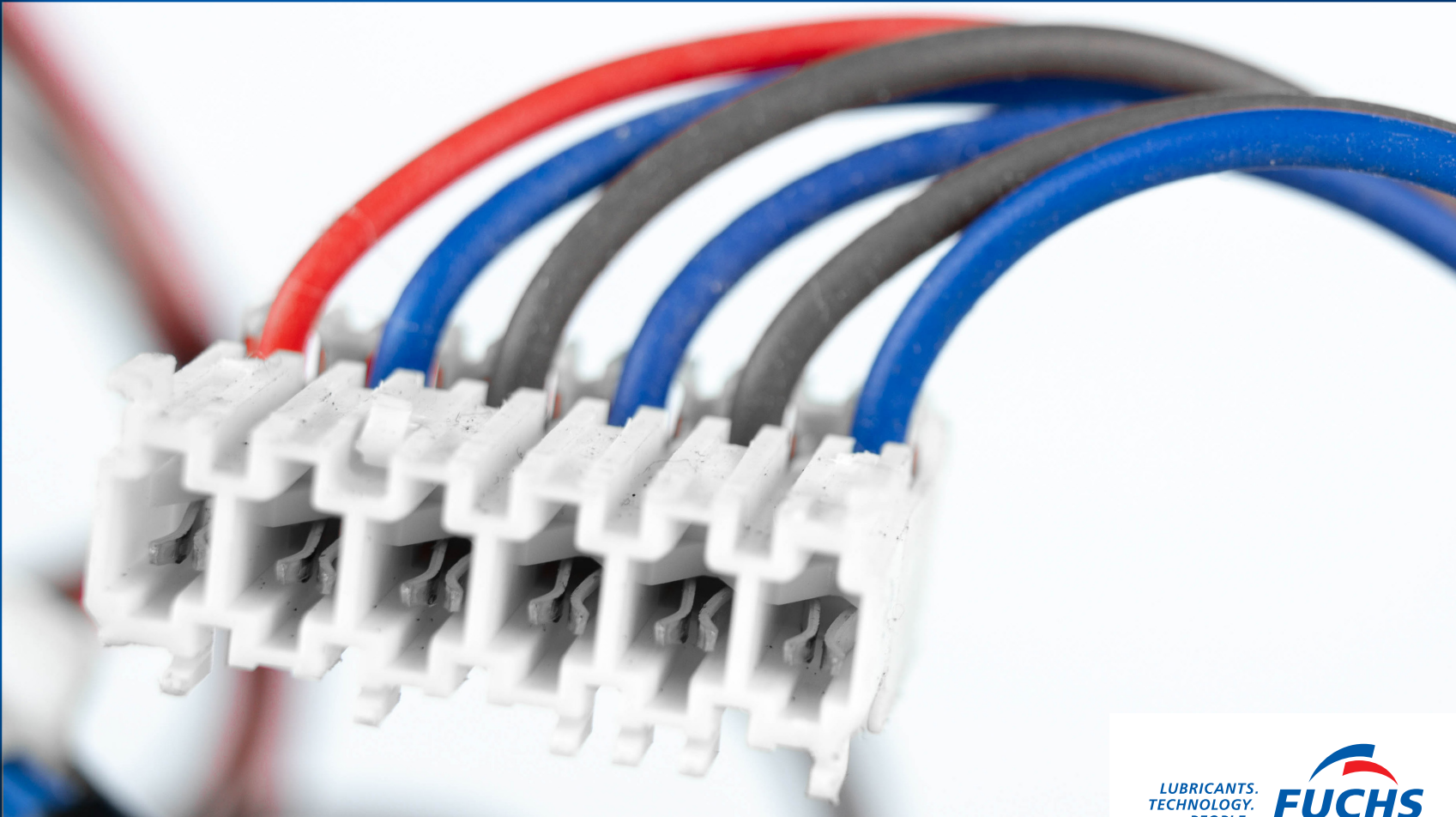


The 4 Biggest Connector Problems and How to Solve Them

Jeff Wheeler - Key Account Manager, Automotive Components



MOVING YOUR WORLD



Table Of Contents

03

Smart Technologies & Hurdles to Adoption

04

Electrified Applications

Types of Connections in Data & Power

05

Different Types of Connector Failures

06 – 11

Causes of Connector Failures

12

Select Your Connector Grease

13

The Proof is in the Performance

Smart Technologies & Hurdles to Adoption

Electrical connectors are a crucial part of virtually every electrically powered and controlled product. Unfortunately, connectors are also the source of many potential problems. This e-book explores the various root causes and failure mechanisms of electrical connectors and how they can be avoided.

The Cost of Electrical Failure

The future is **electric**. This is due in large part to the proliferation of smart, environmentally-friendly electric technologies that send more signals, process more data, and make more decisions, than ever before. These technologies are supported from dozens to hundreds of electrical connections that each represent a potential failure point within the system.

Failure of electric components, from short circuit to continuity loss, can cause a variety of problems that can range from nuisance to increased warranty costs to critical safety problems.

Reliability

If consumers are going to invest in new technologies, they must work reliably for manufacturers to maintain customer satisfaction. Even a non-safety related recall can have a negative impact on the perceived quality of your application and your brand's reputation.

Safety

The loss of continuity across the connectors/contacts can be catastrophic and potentially result in a host of safety issues including failed steering and braking systems in electric vehicles, appliance fires, and medical device failures.



Electrified Applications

Appliances



Automotive



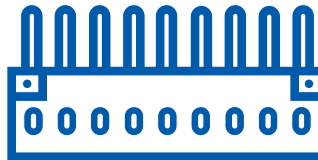
Medical



Robotics

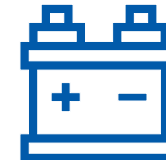


Types of Connections in Data & Power



Multipin Connectors
Multipin connectors range in

size. Each contact pin requires a certain mating force, the more pins (bigger the connector) force that is required to mate them which can cause wear and ergonomic issues. They are also at risk for fretting corrosion during their storage and operation.



Battery Terminals
Battery terminals are often found in automotive and power tool applications where

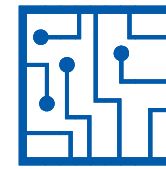
environmental factors can impact electrical reliability. If not protected, salt and dirt can corrode battery terminals; causing either an open connection or a short between positive and negative terminals. Moisture intrusion can have a more immediate effect and cause an instantaneous short circuit as well.



USB Connectors

USB connectors experience more frequent insertions than other types of connectors. This can

lead to more contact wear if not properly lubricated. Like the multipin connectors, USB connectors are also exposed to fretting corrosion during storage and operation.



Printed Circuit Boards

Condensation or moisture can easily pool on the flat surface

of a PCB and cause a short circuit. Dirt can also gather and corrode the PCB contacts over time.

Different Types of Connector Failures

There are three types of electric power and electronic control system failures that connectors can cause:

Short Circuit

A short circuit occurs when there is an unintended connection between at least two pins in a connector. A short circuit can take the form of a blown fuse, a signal fault, or in extreme cases, an electrical fire. Short circuits are often caused by moisture intrusion and terminal corrosion that then bridges the distance between the terminals.

Open Connection

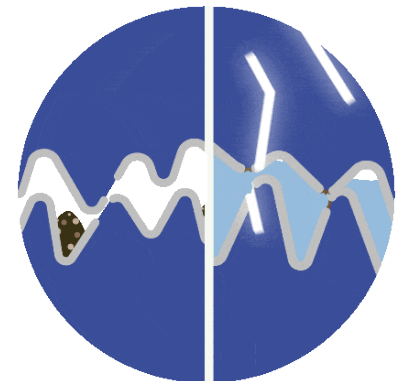
Open connections happen when an electrical path has been broken and current ceases to flow. As a result, there is no power or signal

**Asperity contact completes current flow between connectors. Wear debris and oxides form, separating asperities, creating an open circuit.*

being transferred. An open connection may be caused by a loose connection or excessive terminal oxidation that greatly increases resistance.

Increased Resistance

Wear and corrosion of the terminals can increase the resistance between two connectors. For low power data connectors this can result in faulty signal readings or signal loss. For high power connectors the flow of current through this resistive connection can create heat and even may cause fires.



What are the Top 4 Causes of Connector Failure?

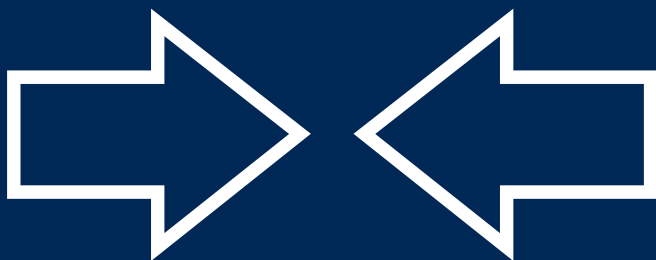


Corrosion

When a contact corrodes, insulative oxides form on the terminal surface which results in increased resistance, signal loss and component failure.



The corrosion can also be conductive and builds up to a point where it bridges the distance between two terminals and creates a short circuit.



High Mating Force

Increased mating force can cause misalignment during assembly and lead to an incomplete connection or damage to terminals.

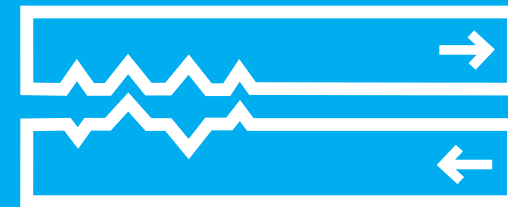


Moisture Intrusion

A lot of moisture can cause an immediate short-circuit whereas a small amount can corrode the connector surface over time.

Fretting Wear

Fretting wear is the result of micromotion caused by vibration and/or thermal expansion. These micromovements wear down through the metal plating into the base material that then oxidizes and increases resistance as well.





Corrosion

Environmental & Chemical

Even with specially designed housings, there is a risk that dust, dirt, or another form of debris could find its way to the contact pin. When this happens, it can interfere with conductivity and lead to a connection that is not solid.

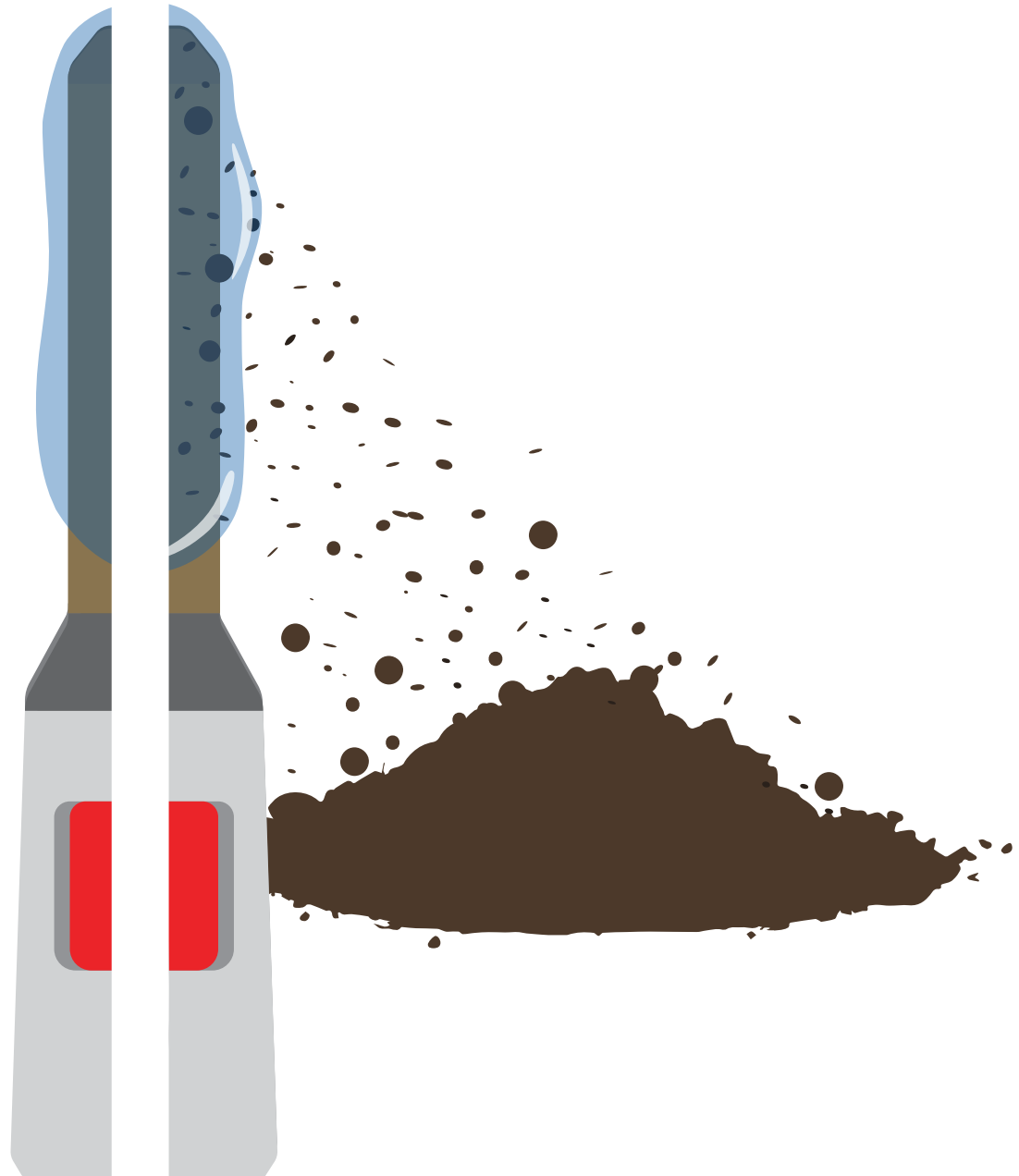
Harsh chemicals can also corrode the metal surface and eat away at the pin's metal plating.



How Grease Helps

Magnets attract, greases don't. Grease creates an environmental barrier to keep dirt and debris away from the contact surface.

PFPE lubricants are recommended to offer protection in the presence of harsh chemicals.



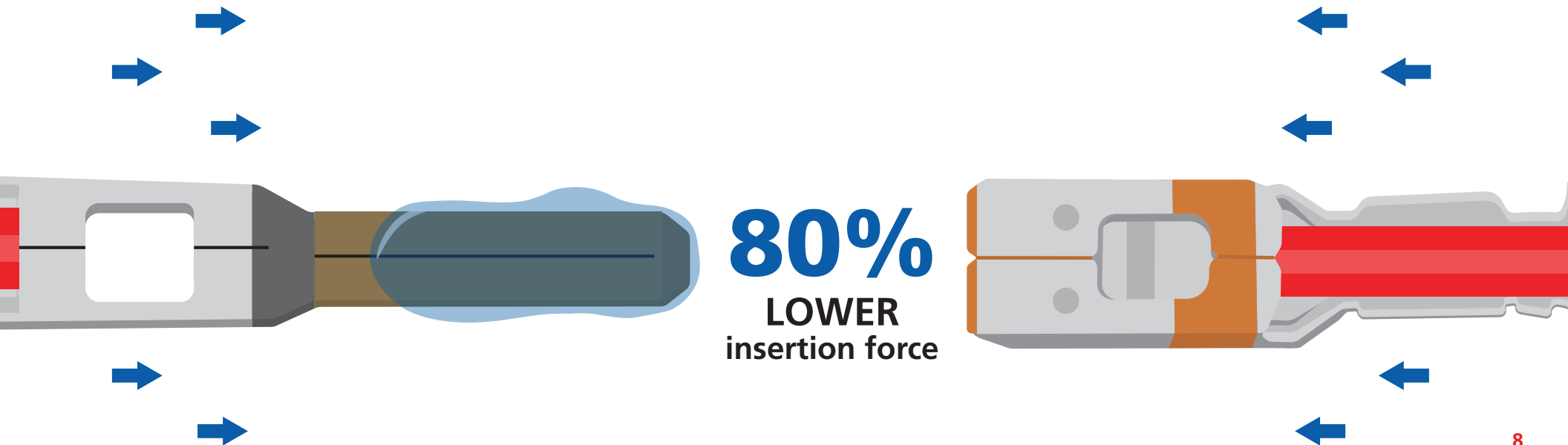
Mating Force

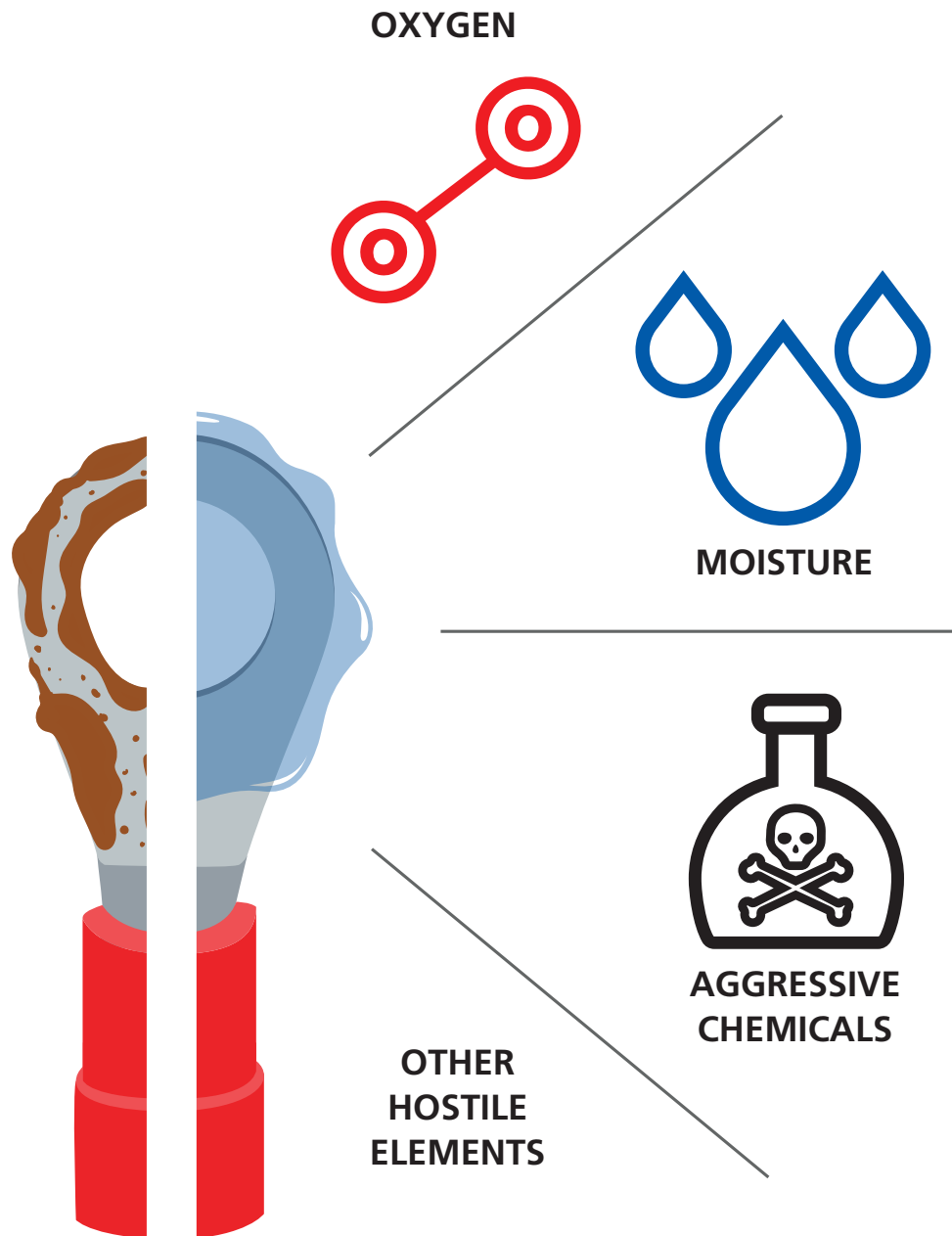
Increased mating force can cause misalignment and/or wear at the metal plating. For multi-pin connectors, mating forces increase significantly which can create ergonomic and safety issues during assembly.



How Grease Helps

A thin film of lubricant reduces friction to ease mating force by as much as 80 percent.





Moisture

Moisture can corrode the terminal surface over time or even cause an instantaneous short circuit. Moisture can take the form of water, detergents, humidity, or salt spray.



How Grease Helps

Connector grease repels water from the connector surface.

Connector grease is hydrophobic, meaning it stays in place rather than being washed away over time.

Connector grease also prevents current leakage in conductive environments, such as water, to ensure consistent connectivity.

A connector grease can also create a seal for the connector to prevent water ingress at the housing interface.



Fretting Corrosion

The Silent Killer

Fretting corrosion is the result of micromotion caused by vibration and/or thermal expansion due to heating or cooling cycles. These micromovements wear down through the metal plating into the base material that then becomes oxidized.

As this oxide layer builds up and increases, the oxide film acts as an insulator between the contacts. This creates an open circuit resulting in voltage drop across the terminal and ultimately, power failure or signal loss.



How Grease Helps

Grease reduces physical wear between the connecting surfaces as they undergo micromotions and fretting wear. This preserves the plating on the connectors, designed to prevent oxidation and minimize resistance.

Grease also protects the system from the surrounding environment, preventing the build-up of insulative oxide layers which are ultimately responsible for resistance increase and signal loss.

Corrosion Case Study

Protecting Battery Terminals Against Corrosion

Commercial vehicles are operated for extensive periods of time under a variety of environmental conditions and depend on reliable components that require shortened and/or infrequent servicing. These vehicles are continuously exposed to road spray, which in the winter contains corrosive salts and chemicals.

Problem

A Commercial Vehicle OEM needed to extend the life of their battery, starter and alternator terminals, and ground straps to protect them from corrosion.

A grease that offered water spray resistance, protection against road salt, humidity, and water was needed.

Solution

NyoGel® 760G Connector Grease

- Excellent water spray resistance
- Superior corrosion protection
- Provides lifetime lubrication for lasting connections
- Low oil separation



Select Your Connector Grease

Nye Lubricants, a member of the FUCHS Group, has a complete line of dielectric greases designed specifically to address application requirements for contact protection, insertion force, sealing, temperature limits and material compatibility.

NyoGel® 760G

Leading connector grease across several industries with specification at a wide-range of leading OEM's. Good fretting corrosion protection and dielectric isolation capabilities. Common connector material compatibility.

Rheotemp™ 768G

Similar performance as NyoGel® 760G, with a higher maximum temperature capability of 175 °C.

Rheotemp™ 769G

Formulated to offer outstanding dielectric performance, reduction of insertion force, and fretting wear protection as well.

Uniflor™ 8917

Recommended for applications with high operating temperatures up to 225 °C. Compatible with a wide range of plastics and elastomers. Excellent insertion force reduction.

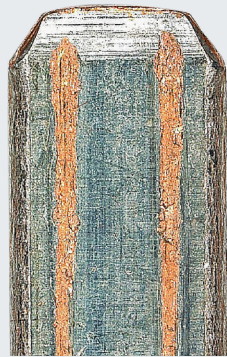


The Proof is in the Performance

Connector Life: Fretting Cycles to Failure Point

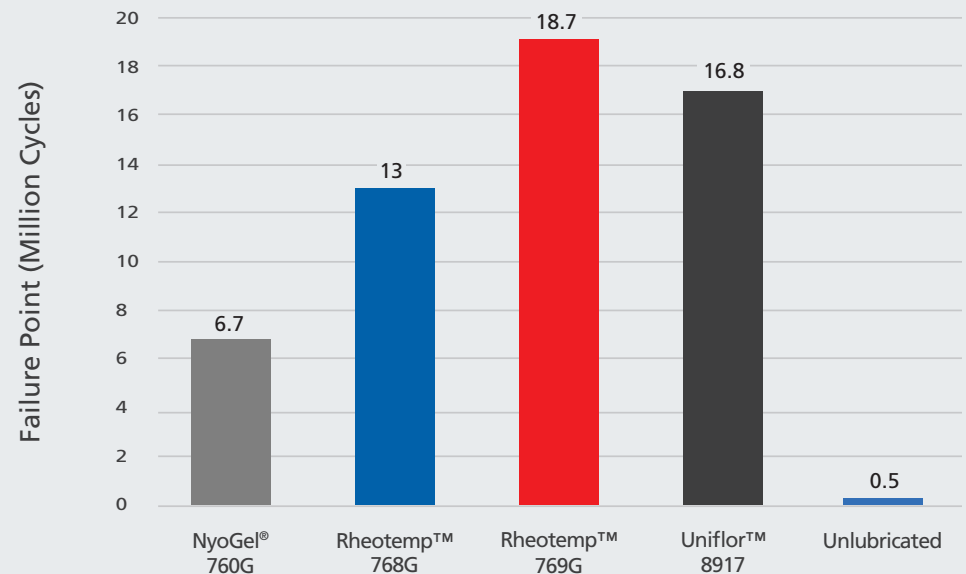


NYOGEL® 760G
6.7MM cycles



UNLUBRICATED
0.5MM cycles

Test Conditions: 2.8mm APEX Copper-Tin Terminals, CTM (10Hz, 100 microns), 50% Failure Values



Conclusion

Electrical connectors are an essential component of all electrical products. Environmental influences such as moisture and vibration can negatively affect the reliability of the electrical connections and may result in product failures. These issues can be eliminated by using specially formulated connector greases.

Industry Leaders Trust FUCHS Connector Grease

Every lubricant change should be preceded by expert consultation on the application in question. Only then the best lubricant system can be selected. Experienced FUCHS engineers will be glad to advise on products for the application in question and also on our full range of lubricants.

Meet The Author *Jeff Wheeler*

Jeff Wheeler has been with Nye Lubricants, a Member of the FUCHS Group, for six years as a part of our automotive team. Within the automotive team Jeff helps customers find lubrication solutions for their electrified systems and components. Prior to working for Nye, Jeff worked as an engineer for the United States Steel Corporation. Jeff holds a Bachelor of Science degree in Chemical Engineering from Michigan State University.

Contact him at jeff.wheeler@fuchs.com.

US Division
FUCHS Lubricants CO
17050 Lathrop Avenue
Harvey, Illinois 60426
Phone: +1 708-333-8900
Fax: +1 708-333-9180