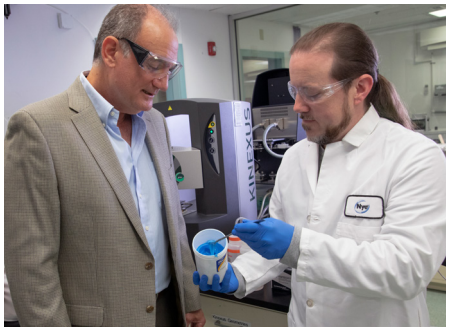
Since 1844

# Nye® LubeLetter

July 2020


## Lubrication

## Collaboration



## Innovation

# Lubrication Basics

## How to Select a Grease or Oil

Lubricants protect your components from wear and corrosion and should be treated as a critical design component. But different lubricant chemistries are better suited for different designs and the wrong lubricant can do your application more harm than good. Just like you validate other parts of your design, you want to make sure that your lubricant is compatible with your applications operating requirements. Here are some things you should consider when selecting a lubricant for your application:


### Grease or Oil?

The first question many engineers struggle with is: grease or oil? In some applications, oil may end up being the only viable alternative. Sintered or powdered-metal bearings are designed to be impregnated with oil. Small delicate mechanisms with extremely low starting torque, like those found in watches, micrometers, or other precision instruments, may also require oil if they lack the motive force to overcome even the lightest grease. With those few exceptions in mind, engineers should never quickly dismiss grease because it does offer cost and performance advantages over oil.

Grease generally stays where it's put, so engineers can eliminate the cost of oil seals and seal design, which are essential to prevent leakage in an oil-lubricated component. Greases also prevent wear better than oils and are more forgiving, allowing engineers to be somewhat less exacting about perfectly mated parts. Importantly, greases can be formulated light enough to accommodate components with low start-up torque.

### Operating Temperature

What is the operating temperature range of your application? A lubricant must be chemically stable at your high-temperature limit and have sufficient film strength to adequately prevent wear. At the lowest expected temperature, your lubricant must remain sufficiently fluid. Certain lubricant chemistries, like perfluoropolyethers, are better suited for applications exposed to

### Material Compatibility

Some lubricants can "attack" certain plastics and elastomers. The base oil can infiltrate the solid material or cause the solid's components to leach into the lubricant. The material compatibility of specific plastics and elastomers should always be tested by evaluating physical properties of your component such as tensile strength, dimensional stability, and gravimetric stability after immersion in the lubricant. Higher temperatures and lower base oil viscosities usually exacerbate chemical incompatibility. Certain metals that come in contact with a lubricant may exhibit

accelerated corrosion or lead to undesirable polymerization or "varnishing" and failure of the lubricant base oil. These problems can be avoided by identifying early in the design process the metal alloys used in the device and analyzing and testing their compatibility with candidate lubricants and additives. Click here to view our material compatibility guide.

### Operating Environment

The end-use environment for the device should be considered. Is it corrosive? Is dust an issue? Will the lubricant be exposed to water, steam, solvents, or solvent fumes? Will the part see temperature cycling? Is micro-vibration a possibility? Will your component be exposed to in-vacuum conditions that require virtually no outgassing or particle generation? Just as other parts of the component are designed to withstand operating conditions, the lubricant must also be designed with these constraints in mind.

### Component Life Requirements

Some applications require what we like to call "Lube for Life" lubrication. In applications where servicing is impossible or difficult, such as space or closed gear-box applications, a grease or oil must be able to lubricate the component for its entire life expectancy. Life testing data should be requested for such applications.



### Load Conditions

For most applications, the prevention of wear caused by friction is the primary reason for the use of a lubricant. In general, higher viscosity base oils support heavier loads. If the load in the contact zone is too great or the speed is too slow, asperities on the rubbing surfaces can collide, causing excessive wear. In this situation, which is referred to as boundary lubrication, extreme pressure (EP) additives may be necessary. Synthetic ester greases are particularly suited for preventing heavily loaded metal-on-metal wear. Under relatively light loading, the high surface energy of a silicone grease may help to re-wet the surface.

### Design Goals

Lubricants do much more than just prevent wear. Lubricants can also be used to achieve specific design goals that would normally be fulfilled through mechanical parts. Grease can:

- Eliminate Buzz, Squeaks, and Rattles
- Control precision motion
- Reduce noise, vibration, and harshness
- Reduce temperatures
- Reduce torque

Perhaps most importantly, by spec-ing in a grease during the design phase, you protect your components before damage can be done to reduce risk and warranty claims. Our monthly newsletter has dozens of in-depth articles about how lubricants can enhance design performance to address common industry issues.


### Delivery and Handling

How the lubricant is applied to the device during manufacture is often critical to its success. The correct amount must be applied in the right location. In some applications, too much lubricant can be more detrimental than too little. Cleanliness of the lubricant is also an issue. Containers should be kept closed and exposure to contaminants minimized. Often the use of automated dispensing systems can preserve lubricant cleanliness and ensure that repeatable quantities are applied to the part. Some precision components, like those found in HDD bearings, may require that a lubricant be cleaned through microscopic ultra-filtration.

### Application Requirements

Different types of devices can have a wide variety of lubrication requirements. An electric switch that carries low current within a non-inductive circuit will require a different lubricant that one that has the potential to arc during the make–break of an inductive circuit load. A bearing that supports a rotating shaft will have a lubricant system different than a set of plastic gears. The ultimate application of the component and the likely mode of failure determined must be considered.

**Many specialized lubricants have been developed for specific parts, including:**

- Ball and Lead Screws
- Bearings
- Connectors
- Gears
- Slides
- Switches

Choosing a lubricant designed for the device at hand is the key. Some applications may also face industry constraints such as defense specifications, food-grade requirements, or biocompatibility concerns. Click here to explore our lubricants by industry.

Lubrication is a science. If you need help selecting the right lubricant for your application our engineers are ready to help. Contact us today.

# NyeClean® 5057: REACH-Compliant In-Vacuum Grease

Nye Lubricants recently developed NyeClean® 5057, a PTFE thickened, medium viscosity, completely fluorinated grease. 5057 will replace a heritage semiconductor/in-vacuum lubricant that was recently discontinued after the introduction of new PFOA regulations.

## Clean, Compliant Grease

NyeClean® 5057 is recommended for use in-vacuum environments and was formulated specifically for bearings within semiconductor manufacturing equipment that require a durable and clean lubricant. NyeClean® 5057 is an inert grease that demonstrates excellent thermal and chemical stability, while also being resistant to solvents. NyeClean® 5057 complies with Annex XVII of REACH Regulation (EC) No. 1907/2006 and its amendments for Perfluorooctane sulfonates (PFOS) content (Formerly Directive 2006/122/EC).

This new grease was formulated using a unique perfluoropolyether (PFPE) base oil that remains stable over a wide temperature range (-50°C to +250°C) to accommodate of demanding in-vacuum and environmental conditions. This base oil is characterized by a unique polymeric stability when in contact with a variety of metals at high temperatures.

| Properties | Test Conditions | NyeClean® 5057 | Test Method |
|---|---|---|---|
| Chemistry | – | PFPE / PTFE | – |
| Temperature Range | – | -50 to 250 °C | – |
| Kinematic Viscosity | 40 °C | 192 cSt | ASTM D445 |
| NLGI Grade | – | 2 | ASTM D1403 |
| Oil Separation | 24 hr, 100 °C | 5.80 wt% | ASTM D6184 |
| Evaporation | 24 hr, 100 °C | 0.00 wt% | ASTM D972 |
| 4-Ball Wear | 1 h, 1200 rpm, 75 °C | 20 kgf= 0.44 mm<br>40 kgf =1.15 mm | ASTM D2266 |
| Microscopic Particulate Contamination | 10-34 $\mu$m | <250 particles/cc | FED-STD-791 Method 3005.4 |

### Meeting REACH Requirements

Thickened with a unique Polytetrafluoroethylene (PTFE) synthetic polymer, NyeClean® 5057 improves the friction, wear and energy consumption in the components where this lubricant is used. NyeClean® 5057 was validated using an exhaustive testing protocol to ensure that this new grease complies with the strict new regulatory statues.

Under REACH legislation passed in June 2017, products sold to or manufactured within the European Union will be limited to 25 parts per billion (ppb) of PFOA and its salt concentrations. All manufacturers are expected to fully comply by July of 2020 and there has been a push from healthcare, environmental, and other organizations to pass similar legislation in the United States. In fact, in February 2020, the SEMI International Standards Program introduced a new standard for the practice of restricting the use of PFOA, its related compounds, or their salts.

In order to properly certify to these new regulations, Nye contracted a respected independent laboratory to test NyeClean® 5057 for PFOS content. The laboratory used solvent extraction followed by analysis using a High-Performance Liquid Chromatography-Mass Spectrophotometer (HPLC-MS). With a Permissible Limit of 50 parts per million (ppm), and with an Equipment Detection Limit of 0.025 ppm, the independent results for PFOS were "Not Detected: PASS." The laboratory then tested for PFOA content using the same method for which NyeClean® 5057 also received a passing rating.

### Sample Today

NyeClean® 5057 meets all of the operating requirements our semiconductor and in-vacuum customers are looking for while meeting REACH requirements to help manufacturers remain compliant. Applications for NyeClean® 5057 include cleanroom manufacturing, robotics, metrology equipment, LCD/OLED displays manufacturing, bearings, linear guides, and many others.

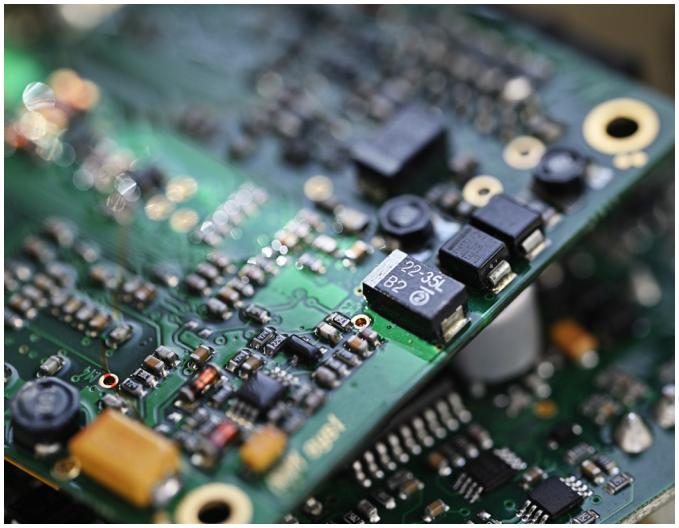
**For samples, technical information, safety data sheets or additional information regarding NyeClean 5057®, Contact Us.**

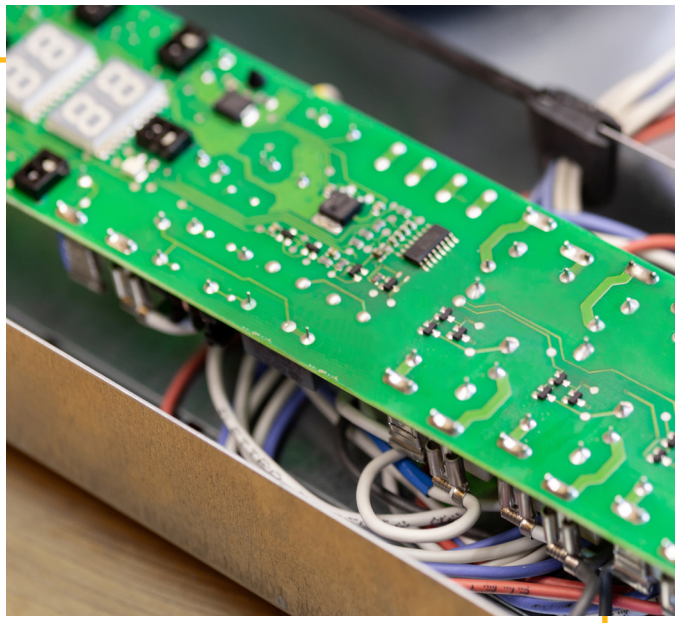
## Case Study: Preventing Fretting Corrosion in Electronic Control Modules

### Background

Electronic control modules (ECMs) perform various functions in automotive vehicles and protecting these components from failure has become even more important with the proliferation of electric vehicles. A leading OEM came to Nye after they noticed one of their vehicles ECMs sent an increased number of diagnostic codes related to open connections.

After further investigation they realized that the connectors had experienced fretting corrosion, or minute vibrations that create oxide-build up that eventually leads to signal loss. The OEM was concerned that this would lead to braking-related safety issues including cruise control, lights, shifting out of park, etc. They approached Nye to see if we had a grease that would prevent fretting corrosion and restore connectivity to affected vehicles.





## Challenge

- Can Nye's grease prevent fretting corrosion to eliminate oxide buildup around the connector terminals?
- Can we provide a grease that exhibits material compatibility with the plastics and elastomers used in the connector and control module housings?

## Soultion

**NyoGel® 760G**

***A silica thickened, medium viscosity, synthetic hydrocarbon grease.***

- Formulated to prevent fretting corrosion
- Compatible with most plastics and elastomers
- Copper passivator prevents copper corrosion
- Provides lifetime lubrication for lasting connections
- OEM Specifications: Ford: WSB-M1C239-A, GM: 9986087, & DaimlerChrysler: MS-9496

| Product | Chemistry | Temperture Range | Water Washout (1hr @ 80 °C) | Copper Corrosion (24 hr @150 °C) |
|---|---|---|---|---|
| NyoGel® 760G | PAO/Silica | -40 to 135 °C | 2% | 1a, Slight Tarnish |

## Results

Nye recommended that the OEM use NyoGel® 760G, our industry standard grease for connector applications, and completed in-house validation tests for material compatibility, fretting protection, and copper corrosion protection. The OEM ultimately chose NyoGel® 760G as their connector solution because it provided the necessary fretting protection against vehicle vibration to eliminate oxide buildup around the terminals. NyoGel® 760G is now the OEMs go-to solution for recalls and to protect other control modules from failure.

## Meet The Author

***Jeffrey Wheeler - Regional Engineering Manager (Electric & Autonomous Systems)***

Jeff Wheeler has been with Nye for three years as a part of our automotive team working out of the Detroit office. 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.
Click here *to contact Jeffrey Wheeler today.*

## What are Lubrication Regimes?

Lubrication regimes describe the type of lubrication film that is created under specific operating conditions and is dependent on the degree of contact between surfaces. There are three primary lubrication regimes: Boundary, Mixed, and Hydrodynamic Lubrication.

*Let's explain using the example of water skiing in this video.*

### Boundary Lubrication

During boundary lubrication, opposing surfaces meet with little or no oil film separation. In this regime, damage is prevented by protective additives that promote sliding rather than welding of surface asperities. This regime typically occurs at low speeds. Imagine you were driving a speed boat. If you gave the boat just a little bit of throttle the nose of the boat would go up and the back of the boat would be angled in the water. When half of the boat is still in the water, it creates drag. The same thing would happen on water skis when you're first trying to get up and going in the water. This is a great example of boundary lubrication.

### Hydrodynamic Lubrication

During hydrodynamic lubrication, moving parts are completely separated by a viscous fluid film. This regime typically occurs at high speeds. Back to our previous example, imagine now the boat has been at maximum throttle for long enough that you reach full speed. At full speed, the nose of the boat comes down and you move so fast that you just skim over the top layer of water. While we definitely do not recommend trying this at home, this example demonstrates hydrodynamic lubrication.

### Mixed Lubrication

Mixed lubrication occurs during the transition from low to high speed operation when boundary and hydrodynamic conditions coincide, the asperities of bounding surfaces will extend through the film and occasionally come in contact.

Finally, imagine you gave your boat maximum throttle. At first, the boats nose will come down a bit as the boat is accelerating, but you haven't reached the maximum speed the boat can go. At this point, your water skis have balanced and you are cruising along under similar conditions to mixed lubrication.



Understanding the difference between lubrication regimes is critical in selecting the right lubricant for your application that will protect your component and prevent wear. Now that you understand the basics of the lubrication regimes you are ready to ask the right questions when selecting a lubricant for your application!

# Meet Nye - Brad Richardson

Meet Brad Richardson, Nye's Vice President of Business Development. In his position, Brad leads the Sales, Marketing and Sales Operations teams at Nye and has grown and developed Nye's successful and world respected technical sales organization. Brad has been involved in patented product design, development and market introduction for more than 30 years, approaching 25 of those in business development with Nye Lubricants.


Brad received a Bachelor of Science in Mechanical Engineering from the Milwaukee School of Engineering in 1987. He later plied his engineering and management skills in fluid mechanics and the dental industry before joining Nye in 1995 as an Engineering Sales Manager. He received an MBA in Strategic Management from DePaul University's Kellstadt Graduate School of Business in 2001. Prior to assuming his current position, he was named Nye's Director of Sales in 2007 and Director, Senior Accounts Executive in 2014. Brad resides in the northern suburbs of Illinois where he works out of Nye's Chicago Regional office.

**This year will be your 25th Anniversary at Nye, how have you seen Nye change over the years?**

I was the fifth Regional Engineering Manager hired in 1995. Nye employed 65 people at the time, and we had approximately $12million in revenue. We now have 18 REMs and Industry Managers, 180 Nye Teammates in the company and we have jumped over the $50 million mark in revenue.

**Nye was acquired by Fuchs Petrolub SE earlier this year. What has the transition from privately owned company to independently owned subsidiary been like?**

We are now owned by Fuchs Lubricants Corporation out of Harvey, IL, which is part of the global Fuchs Group out of Manheim, Germany. We're beginning to see a whole new, expansive world of opportunities! The collaboration on the Business Development side has been going very smoothly and we see many synergies amongst the teams. Also, I see the same in other functional areas between the two companies. I think we're going to have some fun with our new colleagues!

**How will Nye and Fuchs work together towards these goals in the future?**

The work being done now in just four months since the Fuchs Group acquired Nye has been moving rapidly! The work being done in Product Management and R&D has brought together Nye and Fuchs people from all over the world in many disciplines. Together, we have begun mapping out plans that will be incorporated into the Fuchs 2025 Strategy where colleagues from every Fuchs global entity is involved. It's been, and will continue to be, quite an endeavor!

**What is your favorite part about working at Nye?**

I have the opportunity to work on a myriad of applications in different industries every day. I might be speaking to someone from NASA about a satellite bearing one day and the next, an engineer designing a power tool or bicycle component. You never know what the next application will be!

**What is your favorite part about working for Nye?**

I have to say, my time here has been very rewarding and a real pleasure to be able to contribute to our top line growth, working on a wonderful range of applications and exercising my engineering "chops" along the way.

Also, the relationships I've enjoyed with my colleagues over the years has been a true, rewarding experience. I really look forward to continuing to grow in these and getting to know better our new Fuchs colleagues and developing those relationships!

**Stay tuned for more updates** next month!

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