

Since 1844  
**Nye**® **LubeLetter**  
February 2021



### Lubrication



### Collaboration



### Innovation





## Drug Delivery Devices:

### How Can Drug Delivery Devices Benefit from Gels & Fluids?

Technological, regulatory, and market forces have been driving advancements in the expanding parenteral (non-oral administration) drug delivery device industry which have improved the lives of millions of people. One is the proliferation and availability of highly effective disease-targeting **biopharmaceuticals**. Another is the trend toward more convenient, lower cost, in-home and self-administered patient care, often replacing the need for regular and extended IV treatments in the hospital or clinic. A third involves the implementation of microelectronics and digital connectivity -- the integration of data monitoring, tracking and communication systems with the device, patient, and caregiver.

As new parenteral drug products are developed, they often require easy-to-use, precise, consistent, portable, safe, and environmentally stable devices to deliver the active drug formulation, often in liquid or powder form, to the body. The biopharmaceutical industry and their design and manufacturing partners adapt existing devices or engineer new designs for the ever-expanding variety of drug molecules and formulations created by scientists. These devices include **autoinjectors, on-body injectors, injection pens, pumps, inhalers (both nasal and pulmonary) and infusion systems**. Additionally, training devices exist that help patients practice administration.

Delivery device operation must be matched to the drug therapeutic and stability profile, dosage form, route of administration, dose accuracy requirements, patient population and other parameters necessary for successful product launch in target markets. Functionality, useability, and manufacturability requirements create challenges for designers modifying existing devices for new uses, or those creating entirely new and sophisticated device platforms. If successful, the device yields an improved patient experience, high medication adherence, good clinical outcomes, and strong market penetration.

To drive drug delivery and other events such as injection needle delay time and retraction, devices may contain powerful energy sources such as springs, battery-powered electromechanical drives, or pressurized gas. Carefully designed, innocuous, and precisely controlled lubricants and motion control (damping) gels from Nye assist device designers and manufacturers confronted with design and modification **challenges such as:**

- Control of drive force, vibration, & haptic feedback
- Optimization of metering & signaling
- Shock absorption
- Unexpected or undesired inter-component friction
- Mechanism timing



Nye's gels and fluids, which can be customized for the application, either lubricate contacting surface, protect microelectronic electrical contacts, or provide controlled and consistent viscous drag on moving parts.

## Precision Motion Control Gels & Fluids Enable:

- Proven Performance Over the Operational Temperature Range
- Optimum Device Functionality, Useability & Patient Safety
- Stable Device Performance Over the Required Shelf Life

## Considerations When Selecting Gels & Fluids for Drug Delivery Devices

### Quality

To reduce risk, device designers select suppliers and partners with strict quality systems and standards. As an [ISO 13485:2016 manufacturer](#), Nye Lubricants' quality management system meets regulatory requirements for medical devices and related services. Our manufacturing processes are strictly followed and documented to support our customers' needs for product traceability as well as audit and regulatory support.

### Controlled, Stable, & Consistent Physical Properties

Tightly controlled performance is key to ensure every device operates to its design intent, providing each patient with the same experience every time. Nye verifies that our gels and fluids are manufactured reliably with excellent batch-to-batch consistency. We partner with customers to select or design products for program success.

### Appropriate Operating Temperature Range

Gels and fluids for drug delivery devices must provide consistent performance within the design limits of the device and over a

wide range of temperatures --- from processing, distribution, shipment, and cold storage to device actuation. We design our products to meet these demanding criteria, ensuring devices work as intended every time, in every application.

### Material Compatibility

It is important to select a gel or fluid that stays in its intended location, is structurally stable over a long time, and is compatible with all the materials of construction in your design. Some lubricants can plasticize and soften certain plastics and elastomers. Nye offers material compatibility testing and other [testing services](#) to ensure you select the best product for all your applications.

### Biocompatibility

Besides standard, specialty and custom motion control gels and fluids, Nye provides a range of biocompatible [NyeMed®](#) products for consideration, tested against ISO 10993 protocols. Some of these products are superb at protecting electrical contacts and connectors, which are present in many devices.



## Partner with the Industry Experts!

Nye has a strong heritage in the parenteral drug delivery device industry, with the global reach and depth to take on your projects, collaborate with your partners, and bring projects to a successful conclusion. Our experienced R&D scientists work directly with our customers' design teams to understand their device and performance requirements and can **provide custom solutions and specialized testing**.

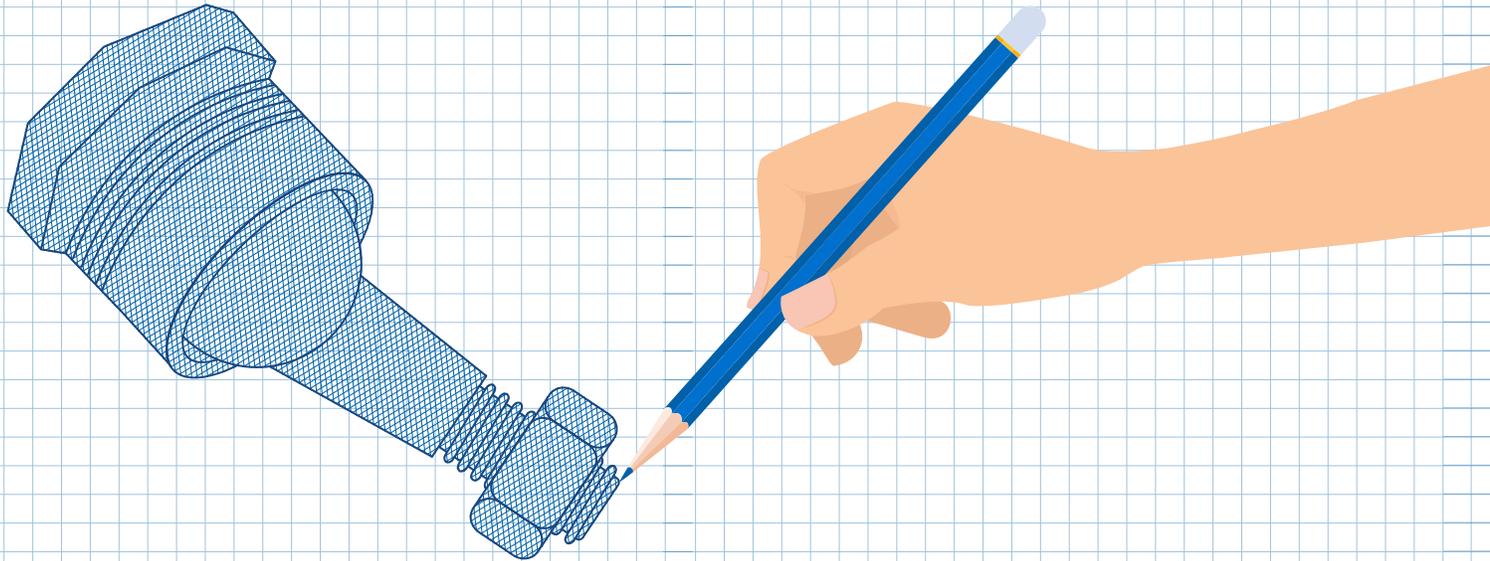
Nye supports our Medical Industry customers from Proof-of-Concept to Industrialization through Post-Production phases..... and far beyond. We'll be there when you need us!

Want to learn more? [Contact us](#) to let us know how we can help with your application.



## Ball Joints

An efficient ball joint design plays a critical role in ensuring a smooth driving experience. Tight-fitting, ball-and-socket designs are subject to dynamic motion in almost every direction and must be protected against wear. Ball joints are exposed to a variety of operating conditions including extreme environmental exposure, engine heat, jolts on rough surfaces, and continuous micro-motion on smooth roads.



### Why Do Ball Joints Need Grease?

Grease provides smooth action for ball joints to operate efficiently and protect against wear. Packaging of ball joints, depending on vehicle design, may place it close to hot engine components where it needs to resist breakdown due to heat. In addition, a ball joint must operate quietly, even after a vehicle has been motionless for long periods of time. Grease also provides protection from environmental conditions to protect components and provide a 'lube for life' solution. The right lubricant will:

- Meet and exceed lifetime durability requirements
- Have excellent low temperature torque
- Extend ball joint life
- Operate quietly with no stick-slip
- Be compatible with boot material
- Reduce wear & friction
- Resist water spray-off

### What is the Best Ball Joint Grease?

Contemporary ball joints are designed without grease fittings, so it is important to select the right lubricant as the initial fill must provide lifetime lubrication. Wide temperature, water and salt water resistant synthetic greases meet these demanding requirements.

### Fluorocarbon Gel 880: Grease for Ball Joints

Nye's [Fluorocarbon Gel 880](#) is a PTFE-thickened, heavy viscosity dimethyl silicone grease with excellent water resistance and structural stability under a wide temperature range and is our recommended solution for most ball joint applications.

Properties	Test Conditions	Fluorocarbon Gel 880	Test Method
Chemistry	–	Dimethyl Silicone/PTFE	–
Service Temperature Range	–	-40 to 200 °C	–
Kinematic Viscosity	40 °C	18407 cSt	ASTM D445
	100 °C	7349 cSt	
NLGI Grade	–	2	ASTM D217
Oil Separation	24 h, 100 °C	0%	ASTM D6184
Evaporation	24 h, 121 °C	0.06%	CTM*

\*CTM: Nye Company Test Method

## Nye as a Member of the FUCHS Group of Companies

Nye's ability to innovate, adapt, and develop solutions is as evident today as it has been at any time during our history. Since our start in 1844, Nye Lubricants has enabled and improved breakthrough products and critical new technologies for more than 175 years. From lubricants for whale ships to spaceships, Nye has always been on the forefront of innovation, and will continue to do so as a wholly owned subsidiary of the FUCHS group of companies. Together, FUCHS and Nye offer a wide product portfolio and a one-stop-shop for all your lubrication needs.



Our lubricants for specialty applications, small volume manufacturing, state-of-the-art research capabilities, and knowledgeable team are proving to be a valuable addition to the global FUCHS portfolio. Sharing best practices, research, and insight into our customers will bring us all closer to achieving our common goal: formulating lubricants that make the world a more innovative, efficient and safer place.

[Click here to watch our new video.](#)



# Case Study: Long-lasting Grease for Satellite Reaction Wheel

## Background

Space applications require some of the most technically sophisticated lubricants. Once launched, mechanisms within these applications are almost impossible to service, which makes selecting the correct lubricant a critical task for design engineers. The wrong lubricant could contaminate the component and cause failures or evaporate and fail to lubricate the mechanism for the life of the application. A leader in the design and manufacture of rockets and spacecraft, approached Nye in search of a grease for their reaction wheel bearings. The reaction wheels in this satellite design would spin continuously for a minimum of five years and required a reliable, long-lasting lubricant that prevents wear under vacuum conditions.



## Challenge

- Can we provide a low outgassing grease with excellent vacuum stability?
- Can Nye provide a grease that will last for, or beyond, the life of the satellite system?

## Solution

### Rheolube® 2000

**A sodium complex soap thickened, medium viscosity, multiply-alkylated cyclopentane grease.**

- Ultrafiltered to remove trace particulates that can cause bearing failure
- Long-lasting Pennzane formulation exclusive to Nye
- Low outgassing and vapor pressure
- Wide-temperature performance

Properties	Test Conditions	Rheolube® 2000	Test Method
Chemistry	–	Cyclopentane/Sodium Soap	–
Temperature Range	–	-45 to 125 °C	–
Kinematic Viscosity	-40 °C	72,000 cSt	ASTM D-445
	40 °C	110 cSt	
	100 °C	15 cSt	
Vacuum Stability	24 h, 100 °C	TML 2.461 wt% CVCm 0.729 wt%	ASTM E595
Knudsen Vapor Pressure	25 °C	1.79 x 10 <sup>-10</sup> Torr	–
SRV	100 N, 50 Hz, 1 mm stroke, 2 h, 40 °C	Coefficient of Friction: 0.11 mm Wear Scar: 0.41 mm	ASTM D5707

Nye engineers worked with the customer to discuss possible solutions including custom formulations as well as our existing line of space lubricants. Using test results gathered by engineers in our [Vacuum Aerospace and Semiconductor Test Laboratory](#), Nye was able to provide them with pre-validation data including outgassing, vapor pressure, and particle generation results. The customer ultimately selected [Rheolube® 2000](#) as it exceeded their vacuum stability and life requirements, and they remain satisfied with its performance.



## Meet Nye - Gus Flaherty

Gus has been at Nye for more than 10 years, getting his start as an Application and Test Design Engineer. Now, he manages the Applications Development and Validation Testing (ADVT) Lab. His teams have designed and built a variety of rigs to test our lubricants on specific applications. Gus holds a Bachelor of Science in Mechanical Engineering from the University of Rhode Island and a Master's in Mechanical Engineering from the University of Massachusetts Dartmouth.



**Gus Flaherty**  
Engineering Development  
& Applications Manager

### ◆ Can you tell us a little bit about the services and capabilities the Nye's Application, Development and Validation Test Lab offers our customers?

The ADVT Lab at Nye bridges the gap between our traditional Research and Development Laboratory, and the end customer. The ADVT Lab is capable of conducting testing from a conceptual level all the way up to the actual customer's components. By performing testing in-house at Nye, we can preselect to best performing lubricants and minimize the number of samples sent to the end customer for evaluation. This allows Nye to sample only the most effective products to our customers, while also saving them time and cost.

### ◆ What role does the ADVT Lab play in developing new lubricants?

The ADVT Lab works in tandem with the R&D Lab when developing new products. The R&D Lab will ensure all the physical property requirements of the product are met, at which point, the ADVT Lab will run tests to ensure the product performs in the manner for which it was intended. These tests may range from more standard ASTM mechanical and tribological tests, all the way up to testing the lubricant in the actual customer's components.

In a full R&D scenario, the ADVT Lab's test data will be analyzed, and if adjustments need to be made to improve performance in certain areas, the R&D lab can adjust, and then re-test to ensure all new products meet all of the performance requirements for the application or industry.

◆ **What new technology has the ADVT Lab developed to formulate and validate solutions for electric vehicles and other e-mobility applications?**

Recently, the ADVT Lab has developed a full Electric Power Steering Testing Suite. The capabilities within this testing suite allow Nye's Application engineers to test various designs and geometries of customer EPS systems in a variety of loading and environmental scenarios. Data generation consists of, but is not limited to: Efficiency, torque stability, gear mesh interface temperature, and wear analysis.

Additionally, the ADVT Lab has developed an Electric Motor Efficiency Rig (EMER) aimed at optimizing the efficiency of Nye products intended for small electrical motors, actuators, and servos. Reducing power consumption while providing extended life performance in these applications is critical in the success of Electric Vehicle platforms.

**How does the Vacuum, Aerospace and Semiconductor Test (VAST) Laboratory differ from the ADVT Lab?**

The [VAST Lab](#) is a laboratory created for and dedicated to testing which pertains directly to our In-Vacuum, Aerospace, and Semiconductor customers. Many of these customers utilize our lubricants in vacuum environments. The VAST Lab contains all our vacuum equipment and test rigs, some of which are capable of reaching  $10^{-10}$  Torr! Due to the sensitivity of these test rigs, balances, and other components, it was important to isolate this laboratory from the rest of our lab spaces in order to minimize foot traffic, contamination, and reduce static interference. This ensures that our testing can be conducted as precisely and accurately as possible.

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

My favorite part about working at Nye is the vast array of projects types I get to be a part of over the course of the work week. I can start the week off designing and validating a test rig for a steering application for an automotive customer, and by the end of the week I might be running aerospace lubricant testing for a product destined for a satellite or NASA. The ability to succeed in so many different industries is one of the most rewarding parts about working at Nye.



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more updates  
next month!**

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