DuPont™ Krytox® Performance Lubricants Product Overview

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Krytox® Oils and Greases *Product Overview*

Selection of the best lubricant involves analyzing your operating conditions and choosing from the many synthetic and petroleum based products. Most petroleum products begin to degrade before 99°C (210°F) and cease turning at temperatures just below –18°C (0°F). Krytox® synthetic lubricants have operating ranges from <–70 to 316°C (<–94 to 600°F).

Krytox® oils and greases are the products of choice for applications where complete nonflammability, oxygen compatibility, and resistance to aggressive chemicals are requirements. These synthetic lubricants provide superior performance and extended life as lubricants, sealants, and dielectrics.

Cost-Effectiveness

As **Table 1** demonstrates, Krytox® lubricants are cost-effective across a wide range of applications, because of their long, useful life relative to traditional hydrocarbons.

Table 1
Life/Cost/Reliability

Application	Typical Hydrocarbon Lubricant	Krytox®
Electric Motor 227°C (440°F), 1,750 rpm	5 days	9 months
Heated Rolls 199°C (390°F), 5,000 rpm	8 months	24 months
Textile Roll 225°C (437°F), 5,400 rpm	1 month	24 months
Pressure Relief Valves	50% failures	Less than 1% failures
Paper Corrugating Machine	$144,000	$3,000

Typical Applications

Aerospace

- Bearing Lubricant
- Sealant
- O-Ring Lubricant
- Oxygen Systems

Industrial

- Paper Corrugating Bearings
- Chemical Plant Maintenance
- Valve Lubricant
- High-Temperature Equipment
- Clean Rooms
- Chlorine and Oxygen Service
- Textile Equipment

Automotive

- Bearing Lubricant
- CV Joints
- Weatherstrip Lubricant
- Antilock Braking Systems

Vacuum Systems

- Vacuum Pump Fluids
- High-Vacuum Greases
- Vacuum System Sealant

Applications

Should I use an oil or a grease?

The functions of lubricants in antifriction bearings are to provide a film of lubricant between rolling elements, races, and separators and to reduce friction, heat, and wear. They also provide protection against corrosion and remove heat. Sealed greased bearings keep dirt out, and oil lubricated systems flush dirt out of the bearing as the oil passes through.

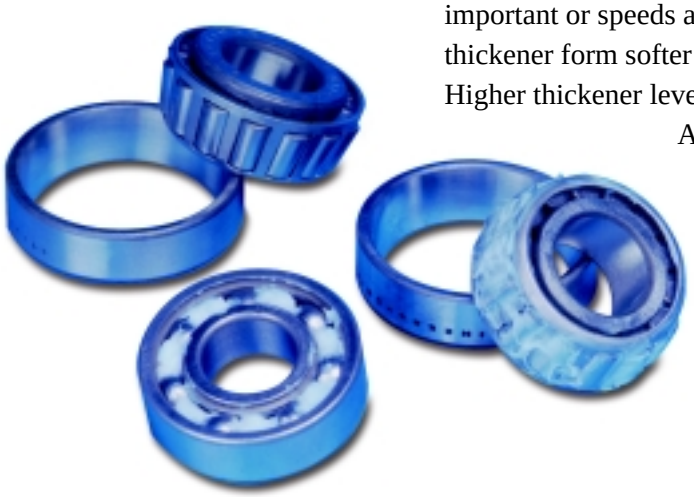
Oils and greases are used over a wide range of speeds and operating temperatures. Selection for a given application is determined by evaluating the bearing housing arrangement, operating temperatures, contamination hazard, bearing type, and load.

Grease is recommended when:

- Simple housings and seals are used that are not designed to retain oil or seal out contaminants.
- Protection is required from dirt, dust, water, fumes, or other contaminants.
- Long intervals between relubrication are required.
- Lubricant contamination of the product must be avoided.

Oil is recommended when:

- The operating temperature is consistently high, and oil flow is needed to remove heat.
- Dirt conditions are not excessive, and oil tight reservoirs and seals can be used.
- It is desired to remove debris from the system using the oil and filter it out with an exterior filter.



Krytox® oils are available in a variety of viscosities. Depending on the specific grade, service temperatures range from <–70–>340°C (<–94–>655°F).

Table 2
NLGI Penetration Ranges

NLGI Grade	NGLI Worked Penetration mm/10 at 25°C (77°F)	Appearance
000	445–475	Fluid
00	400–430	Almost Fluid
0	355–385	Semifluid
1	310–340	Very Soft
2*	265–295	Soft
3	220–250	Cup Grease
4	175–205	Cup Grease
5	130–160	Cup Grease
6	85–115	Block Grease

* Standard grade. Others available upon request.

NLGI Grease Consistency

Greases are formed by mixing the base oil with a thickener to form a grease. Krytox® greases use a special high thickening efficiency, low molecular weight PTFE with very small particle sizes as its thickener. This is one of the most thermally stable thickeners for high-temperature, long-term greases. The lower thickener content in the grease maximizes the oil for improved grease life.

Greases can be formulated with different viscosity oils to handle different temperatures and load conditions. High viscosity oils can be used in greases for high temperatures or heavy loads or low speed applications. Low viscosity oils can be used in greases where low temperature properties are important or speeds are higher. Lower amounts of thickener form softer or more fluid-like greases. Higher thickener levels form harder, stiffer greases. Additives are often added to the grease to enhance anticorrosion protection, raise load carrying ability, or help reduce wear.

Rolling Bearings

Krytox® greases and oils provide a thick lubricating film for bearings. This film reduces metal-to-metal contact in the bearings, resulting in superior load carrying capability.

Before adding Krytox® to a bearing, the bearing should be cleaned of all existing greases, oils, or preservative oils used to protect it during storage. If left in the bearing, these hydrocarbon oils can form carbon deposits at higher temperatures, which may accelerate bearing failure. Chlorinated solvents should not be used, because they can leave chlorine that can cause corrosion. If a bearing has previously been packed with another grease, mechanical agitation or an ultrasonic bath should be used to be sure of removing all of the grease.

After the bearing surfaces are clean, they should be lubricated/wiped with Krytox® and properly stored to prevent corrosion. If they are not going to be packed with Krytox® immediately, or if they are going to be in storage for an extended period, they can be dipped in a solution of Krytox® oil and Krytox® fluorosurfactant to coat the surface and protect against rust.

Proper lubrication is achieved by using the correct amount of grease. Too little grease in the bearings causes premature failure. Too much grease at the initial fill or during relubrication can cause overheating of bearings that are running at medium to high speed, resulting in bearing failure. The amount of grease put in the bearing depends on the application and operating speed. For applications such as conveyor rollers and low-speed machinery with DN values (inner race ID in mm x rpm) below 50,000, the bearing can be filled to capacity. For medium-speed applications, i.e., DN 50,000–200,000, the bearing can be filled 50–70%. For higher-speed systems, the fill is typically 30–40%. Some extreme-speed special applications have grease fills of only 10–15% (see Speed Factor for definition of DN values). Because Krytox® is heavier than hydrocarbon lubricants, its higher density must be considered when determining the fill quantity by weight.

Grease fittings should be changed to a different style, such as button-head or pin type, to ensure that another type of grease is not accidentally put into the bearing. A dedicated grease gun that matches the fitting should be used.

Table 3
Ball Bearing Grease Performance Tests with Krytox® Greases

Test Conditions*	240AB	240AC	283AC	GPL225
10,000 rpm, 204°C (400°F)	—	>500 hr	—	>5000 hr
10,000 rpm, 260°C (500°F)	—	—	>750 hr	—
20,000 rpm, 204°C (400°F)	>500 hr	—	—	—

* ASTM D3336—Light Thrust Load.

Bearings that are converted from oil to grease lubrication generally run hotter internally, because grease does not remove heat as does circulating oil. This higher temperature gradient causes the bearing to expand more and can lead to failure if the bearing does not have adequate internal clearance. Depending on the type of equipment and operating conditions, a bearing with a larger internal clearance might be needed. The bearing or equipment manufacturer should be consulted before converting equipment from oil to grease.

Anticorrosion Lubricants

Additives are combined with Krytox® to enhance its ability to protect metallic surfaces from corrosion caused by moisture and oxygen.

Antiwear Greases

Krytox® greases containing antiwear additives have properties that give high specific load carrying capacity and the highest protection against wear.

Soft/Fluid Greases

These soft or fluid greases have free-flowing characteristics. They belong to NLGI penetration classes 0–000 and are often used for lubrication of sealed gear drives.

Extreme Pressure (EP) Greases

These heavy-duty greases are used for high loading or slow speeds. EP greases have high load carrying capability and good characteristics under boundary and mixed friction conditions. Krytox® is a naturally good EP lubricant, but additional high-pressure additives can be included in the grease.

Table 4
Extreme Pressure Properties* of Krytox® Greases

	240AZ	240AC	250AC	GPL225	GPL226
Load Wear Index	75	127.8	>161	None*	None**
Weld Point, kg	400	620	None	None	None

* ASTM D2596, Measurement of Extreme Pressure Properties of Lubricating Grease, Four Ball Method.

** These samples maxed the load limit of the test apparatus, and a load wear index cannot be determined.

Channeling Greases

Some applications require a grease that is stiff and does not fall back easily into the bearing races. Often, these systems run at higher speeds. Harder NLGI Grade 3 Krytox® greases are recommended for these applications.

Chain Greases

Drive chains, such as roller chains, require lubrication. They are often exposed to the atmosphere and require a lubricant with anticorrosion properties. The lubricant must also have good adhesion and the ability to wet the chain links—characteristics provided by Krytox®. Often, EP additives are included to reduce chain wear caused by oscillating and sliding friction.

High-Temperature Greases

Because of its thermal stability and nonoxidizing characteristics, Krytox® is a natural high-temperature lubricant. Krytox® grease has a drop point of 325°C (617°F). Dropping point (thickener melting point) test results can be confusing or misinterpreted with PTFE thickened greases. Testing shows that some oil separation occurs at about 210°C (410°F), and this has sometimes been reported as the dropping point. Krytox® greases are available with useful temperature ranges up to 288°C (550°F) for continuous use. Special thickener formulations have been blended to give useful lubrication up to 371–399°C (700–750°F) with spikes at 427°C (800°F) or higher with more frequent relubrication.

Low-Temperature Greases

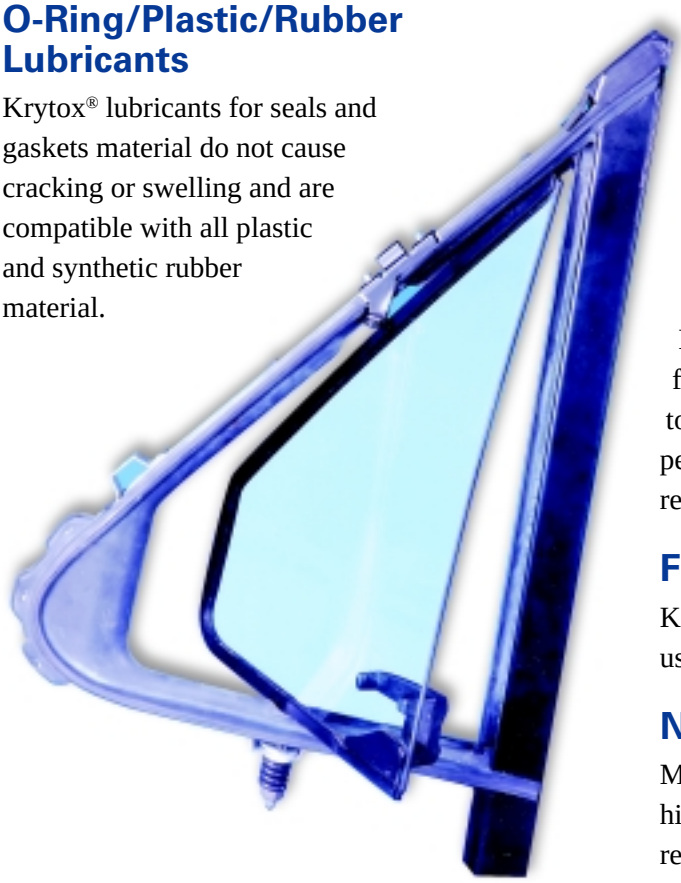
Krytox® grades formulated with low viscosity oils can be used at temperatures as low as –57°C (–70°F).

Valve Lubricants

Krytox® is used in all types of valves to lubricate moving parts, seal connections, and packing and to protect surfaces from corrosion and degradation. Krytox® lubricates the valve packing and allows it to expand and contract without binding, reducing leakage around the stem. Valves operate more smoothly because Krytox® eliminates sticking and jumping. It is used on safety relief valves to prevent sticking and overpressurization.

O-Ring/Plastic/Rubber Lubricants

Krytox® lubricants for seals and gaskets material do not cause cracking or swelling and are compatible with all plastic and synthetic rubber material.



Mechanical Seal Barrier Fluids

Mechanical seals are used in many aggressive chemical reactions. Conventional barrier fluids can violently react with some chemicals. Krytox® can be used as a seal barrier fluid in reactive chemical systems, without fear of reaction occurring between the chemicals and the barrier fluid. Chlorination, fluorination, bromination, nitration, and other aggressive reactions can safely be sealed inside the reaction vessel.

High-Vacuum Greases

A special low vapor pressure Krytox® oil is used to formulate a grease for high-vacuum applications. It is also useful for sealing laboratory glassware connections and as a thread lubricant/sealant.

Vacuum Pump Fluids

Krytox® vacuum pump fluids are used in applications where conventional vacuum pump oils cause safety, waste disposal, and maintenance problems. They are nonflammable and reduce the chance of fire in pumps. They are nonreactive and safe to use in oxygen systems. They can replace any competitive PFPE fluid as well as any other type of vacuum fluid. Krytox® fluids do not contain acetal groups, which are susceptible to attack by Lewis acids. This gives Krytox® superior stability as a vacuum pump fluid. Krytox® vacuum fluids are precisely distilled to provide low vapor pressures and give superior performance. In addition, Krytox® fluids are recyclable.

Food Grade Lubricants

Krytox® greases have a USDA H-2 rating when used in food processing plants.

Nuclear Industry Greases

Many parts of a nuclear power plant are exposed to high heat and humidity or are difficult to access for regreasing. The use of Krytox® with its longer life and high-temperature capabilities allows these parts to run without relubrication for the full fuel cycle. Tests have shown that Krytox® can be used in radiation up to 10^7 rads with no breakdown.

Aerospace Greases

The Krytox® 240 grease series meets a variety of military and industrial specifications. Some of the more common MIL specs and Krytox® products are:

Specification	Krytox® Product
MIL-PRF-27617 Type I	240AZ NLGI 1
MIL-PRF-27617 Type II	240AB
MIL-PRF-27617 Type III	240AC

Grease Mechanical Stability

Krytox® greases have excellent mechanical stability in bearings. They do not break down under mechanical stress and lose their ability to hold oil. The greases were mixed in a grease worker for 60, 10,000, and 100,000 strokes and tested for changes in hardness. All greases tested had changes of less than 30 points on the NLGI penetration scale and were within 1/2 grade of their original starting point. Roll stability tests were performed according to ASTM D1831 for 2 hr with the 4500-lbf reference load. The penetration change was minor and was within 1/2 grade of the original starting point.

Composition

Krytox® is a perfluoropolyether (PFPE)—also called perfluoroalkylether (PFAE) or perfluoropolyalkylether (PFPAE).

Krytox® fluorinated oils are a series of low molecular weight, fluorine end-capped, homopolymers of hexafluoropropylene epoxide with the following chemical structure:

$$F\text{-}(CF\text{-}CF_2\text{-}O)_n\text{-}CF_2CF_3$$
$$\quad\;|$$
$$\quad CF_3 \quad \text{where } n = 10\text{–}60$$

The polymer chain is completely saturated and contains only the elements carbon, oxygen, and fluorine; hydrogen is not present. On a weight basis, a typical Krytox® oil contains 21.6% carbon, 9.4% oxygen, and 69.0% fluorine.

The Chemical Abstracts Index name for Krytox® fluorinated oils is oxirane, trifluoro (trifluoromethyl)-, homopolymer, and the CAS Registry Number is 60164-51-4.

Extreme Pressure Test Results

Table 5
Krytox® Extreme Pressure Properties by the Timken EP Method—ASTM D2509

	OK Load	Score Load	Scar Width at OK Load
GPL214	30 lb	40 lb	1.271 mm
GPL215	30 lb	40 lb	1.507 mm
GPL225	50 lb	60 lb	1.109 mm
GPL295	60 lb	70 lb	1.125 mm

The OK load is the maximum load added to the system at which no scoring or seizure occurs. This load reflects the load carrying capability of the lubricant.

The score load is the minimum load added to the system at which scoring or seizure occurs.

The scar width is the average scar width at the load corresponding to the OK load valve.

Relative Performance

Many synthetic lubricants show excellent performance in one or more categories, but only Krytox® combines stability, nonflammability, and chemical inertness with outstanding lubrication performance under a variety of conditions. **Table 6** compares the relative performance of a variety of lubricants.

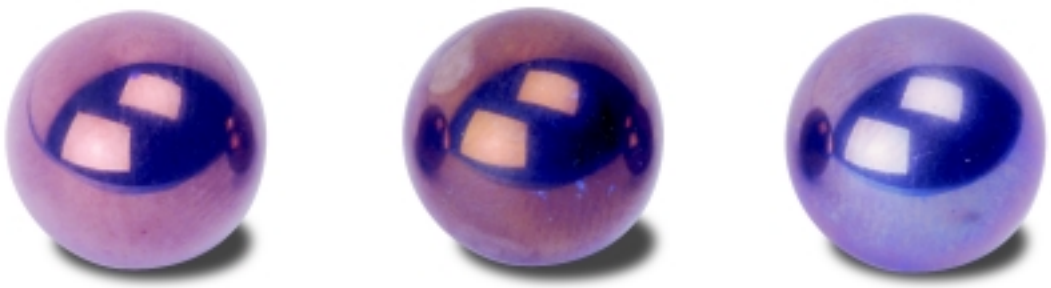


Table 6
Typical Lubricants Wear and Load Carrying Ability

Oil Type	4-Ball Wear Scar, mm*	Falex Pin and V-Block Fail Load, lb
Krytox® PFPAE	0.36	>4,500**
Chlorotrifluoroethylene	0.37	>4,500**
Fluorosilicone	0.43	1,150
Diester	0.61	2,300
Petroleum	0.69	1,300

* 20 kgf, 107°C (225°F), 1200 rpm, 60 min, 52100 steel on steel.
** Test was stopped at 4,500 lb.

Stability

Nonflammable

Krytox® lubricants contain only carbon, oxygen, and fluorine. Because hydrogen is not present, these products are nonflammable. They will not burn or support combustion, even in 100% liquid or gaseous oxygen.

Chemically Inert

Krytox® performance lubricants are not only resistant to oxygen but are inert to virtually all chemicals used in a variety of industries. They are insoluble in most solvents but are soluble in highly fluorinated fluids in some supercritical fluids such as CO_2.

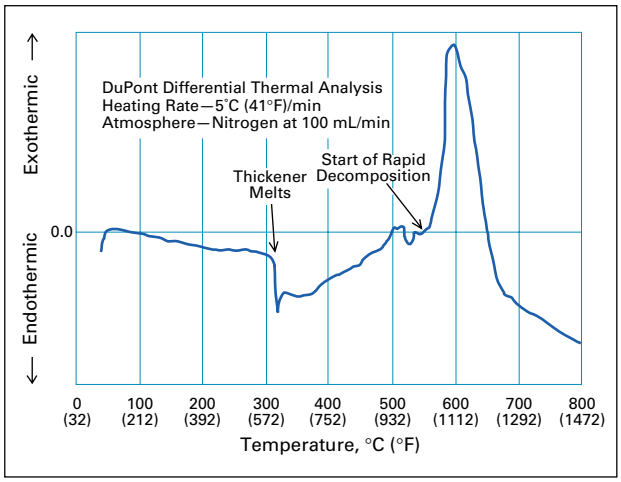
Thermal and Oxidative Stability

The temperature at which thermal decomposition of Krytox® oils takes place depends on the test method used and how the point of incipient deterioration is measured. By differential thermal analysis, deterioration occurs at about 470°C (878°F) in the absence of air. The isoteniscope technique shows an initial decomposition point of 355°C (671°F) as measured by excess pressure increase. At 355°C (671°F), the decomposition rate is approximately 0.03 wt% per day. At 399°C (750°F), the decomposition rate increases to 1.3 wt% per day. When tested under nitrogen for 6 hr at 371°C (700°F), Krytox® showed no increase in neutralization number and no significant change in viscosity.

The presence of air does not substantially lower the decomposition point of Krytox® oils. However, in the presence of certain metal oxides, depolymerization of the oil can start as low as 288°C (550°F). During depolymerization, gaseous decomposition products are given off and the remaining fluid is less viscous, but no sludge or gummy deposits are formed.

In most applications, Krytox® oils have proven serviceable for long periods at continuous temperatures up to 288°C (550°F) and intermittent temperatures of 427°C (800°F). **Figure 1** shows thermal stability of Krytox® fluorinated grease.

Figure 1. Typical Thermal Stability of Krytox® Fluorinated Grease. All grease grades are similar.



Compatibility with Elastomers and Plastics

Krytox® is compatible with all elastomeric seal materials and engineering plastics. The limiting factor when using Krytox® with any material is the thermal stability of the elastomer or plastic.

Krytox® performance lubricants are compatible with the following common elastomers and plastics:

Fluorosilicone
Ethylacrylate
Methyl Silicone
Viton® A Fluoroelastomer
Urethane
Hypalon® Synthetic Rubber
Hytrel® Polyester Elastomer
Butyl 325
Neoprene WRT
Nycar 100 (Buna N)
EPT, Peroxide Cure
Nordel® Hydrocarbon Rubber
Delrin® Acetal
Zytel® Nylon
Vespel®
Teflon® Fluoropolymer
Kalrez® Fluoroelastomer*

* 15–20 vol% swelling at high temperatures when immersed.

Compatibility with Metals

Because of their low surface tensions, Krytox® lubricants easily wet metallic surfaces. Krytox® lubricants are chemically inert and therefore have no adverse effect on metals when the temperature is below 288°C (550°F). Above 288°C (550°F), many alloy steels, stainless steels, and other metals such as aluminum alloy, titanium alloy, nickel alloy, and cobalt alloy can be used with Krytox®.

Compatibility with Oxygen

At elevated temperatures and pressures, perfluoroalkylpolyethers are highly resistant to attack by gaseous and liquid oxygen. As a result, Krytox® fluorinated oils have become preferred lubricants in the oxygen manufacturing industry and in those industries that use oxygen.

Krytox® oils do not react with gaseous oxygen under shock loading or with liquid oxygen (LOX), nitrogen tetroxide, or inhibited red fuming nitric acid in impact tests. LOX impact tests were conducted in accordance with Marshall Space Flight Center MSFC-Spec-106B. Other impact tests conducted at 214 J/cm^2 (200 ft·lb/in^2), according to the method described in ASTM Bulletin 250, also show no reaction.

Krytox® lubricants have also been evaluated by the West German Federal Institute for Materials Testing (Bundesanstalt fuer Materialpruefung, BAM) for reactivity with gaseous and liquid oxygen under pressure. **Table 7** shows oxygen compatibility of Krytox® lubricants.

Elastomeric components are unaffected by Krytox® performance lubricants.

Radiation Stability

Krytox® oils are quite stable to radiation when compared with many materials used as lubricants or power fluids. In general, irradiation of Krytox® oils causes minor depolymerization, with a consequent reduction in viscosity, and formation of volatile products but not solids or sludge. In one test, exposure of a Krytox® sample to an electron bombardment of 10^7 rad at ambient temperature in air resulted in a viscosity decrease of 8%. The irradiated sample contained no sludge and was unchanged in appearance.

Biological Properties

Krytox® fluorinated oils are biologically inert and are not metabolized. They are not biodegradable and do not support any type of biological growth.

Stability to Lewis Acids

Some depolymerization of all perfluoropolyalkylethers occurs at elevated temperatures in the presence of aluminum trichloride, iron (ferric) or zinc chlorides, and boron trifluoride. These so-called Lewis acids, primarily seen in semiconductor manufacturing environments, have significantly less effect on Krytox® than on competitive fluids, due to its molecular structure. Additional data are available upon request.

Table 7
Oxygen Compatibility of Krytox® Lubricants

Test Type	Temperature, °C (°F)	Oxygen Pressure, MPa (psi)	Impact Energy, J (ft·lb)	Test Result
Ignition in gaseous oxygen[a]	400 (752)	13 (1,886)		No ignition
Pressure drop in gaseous oxygen bomb[b]	99 (210)	0.7 (100)		No pressure drop after 600 hr
Mechanical impact in liquid oxygen	Ambient		98 (72)	No reaction in 20 trials[c,d,e]
Mechanical impact in liquid oxygen	Ambient		122 (90)	No reaction in 10 trials[a]
Mechanical impact in liquid oxygen	Ambient		736 (543)	No reaction in multiple trials[f]

[a] British Specification 3100.
[b] American Society for Testing and Materials D942.
[c] Marshall Space Flight Center Specification 106B.
[d] National Aeronautics and Space Administration Handbook, 8060.1B, Test 13, Part 1.
[e] American Society for Testing and Materials D2512.
[f] West German Federal Institute for Materials Testing (BAM), 8104-411.

Viscosity

Viscosity Units

Viscosity is a measure of a fluid's resistance to flow when subjected to external forces. Viscosity expressed in this brochure is kinematic viscosity—the ratio of dynamic or absolute viscosity to density—at the same temperatures. Kinematic viscosity is the value usually measured, but is easily converted to dynamic viscosity as follows:

centistoke x density = centipoise cSt x g/cc = cP

Because of the high density of Krytox® fluids, the dynamic viscosity is almost double the kinematic.

Grease Viscosity

Typically, greases are compared based on the viscosity of their base oil. Because greases are thickened, they have a viscosity that is much higher than the base oil. The grease viscosity is affected by temperature, hardness grades, and base oil viscosity. Values for Krytox® GPL 205 are about 9000 cSt at 25°C (77°F) and 6000 cSt at 100°C (212°F). The viscosity varies with shear rate.

Speed Factor

The speed factor (DN) indicates the permissible speed range for a grease in a rolling bearing. The DN value is the inner race ID in mm x rpm. DN values of 100,000–400,000 and higher have been achieved at temperatures of 204–260°C (400–500°F) in actual field service using Krytox® greases.

The speed factor is affected by the base oil type, in addition to viscosity and thickener type, and is a measure of the lubricant's internal friction. The limiting speed for grease-lubricated rolling bearings is dependent on the type of bearing, its load, speed, precision, and lubrication system.

Electrical Properties

Krytox® oils are good insulators. Their typical dielectric properties are shown in **Table 8**.

The electrical properties of additive-free Krytox® greases approach those of the oils; however, incorporation of some additives may significantly alter these values. In fact, the conductivity of the grease may be increased, if desired, by incorporating a conductive additive, such as powdered copper metal.

Sintered metal components can be lubricated with Krytox®.

Table 8
Oil Electrical Properties

Dielectric Breakdown Voltage, ASTM D877, kV/0.1 in	143AZ	34
	143AA	47
	143AC	56
Specific Resistivity, ASTM D257, ohm·cm		$0.6–4.0 \times 10^{14}$
Dielectric Constant, ASTM D150 at $10^2–10^5$ Hz		2.1–2.2
Dielectric Constant, ASTM D924 at 60 Hz, 25°C (77°F)		2.2–2.4
Dissipation Factor, ASTM D150, % at $10^2–10^5$ Hz		$3.0–7.0 \times 10^{-3}$
Volume Resistivity, ASTM D1169, 25°C (77°F), 500 V, ohm·cm		$2.3–550 \times 10^{12}$

Environmental

Use of Krytox® can help the environment. The original properties of the fluids can be restored through regeneration, so it does not need to be disposed of or incinerated. DuPont has a remanufacturing program that reclaims used fluid and recovers the fluid from used filter elements. This lowers the cost of the fluids and eliminates safety and environmental disposal problems.

This process removes contamination and renews the fluid to new fluid performance. Used in valve packing, Krytox® reduces emissions from stems. Using Krytox® greases and oils eliminates the need for hydrocarbon lubricants and their potential environmental impact. They last longer, so less lubricant is needed. Additionally, they are nontoxic and do not release volatile organic compounds to the atmosphere.

Figure 2. Infrared Spectrum of Krytox® Oil (sodium chloride cell, capillary film). Infrared absorption spectroscopy is generally the quickest and most definitive method of identifying Krytox® oils. All viscosity grades of Krytox® display a spectrum similar to below.

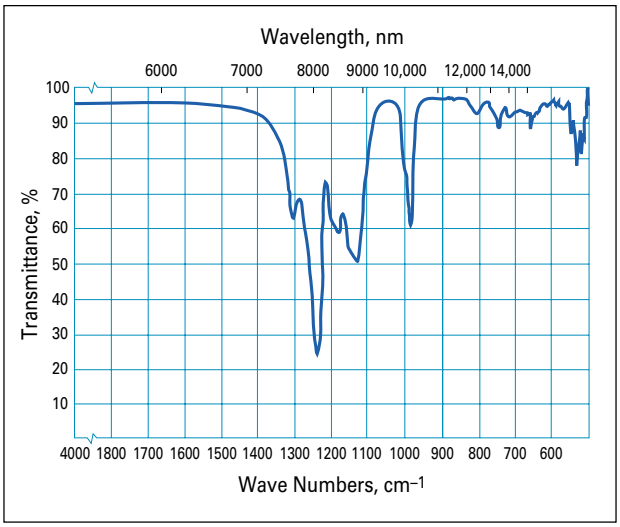
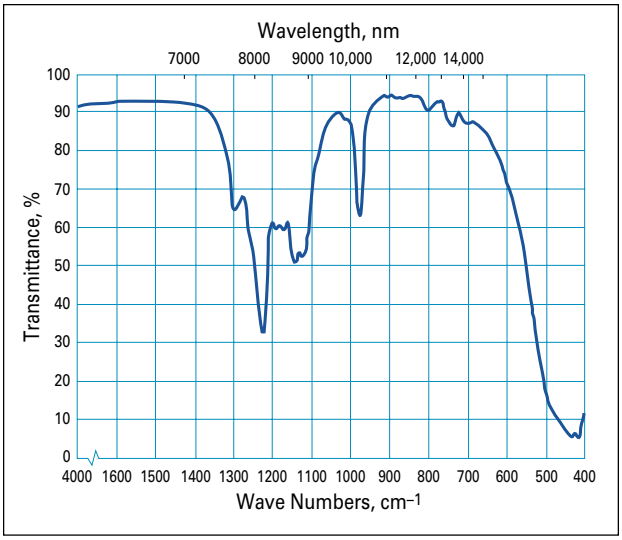


Figure 3. Infrared Spectrum of Krytox® Grease (sodium chloride cell, capillary film). All grades of Krytox® display a spectrum similar to below.



Other Properties

Additional properties of Krytox® are listed in **Table 9**.

Personal Safety, First Aid, and Storage and Handling

Use the most current Material Safety Data Sheet (MSDS) for product-specific information.

Table 9
Typical Properties of Krytox® Fluorinated Oils*

Density**	
24°C (75°F), g/mL	1.86–1.91
204°C (400°F), g/mL	1.52–1.60
24°C (75°F), lb/gal	15.5–16.0
Refractive Index**, nD25	1.296–1.301
Surface Tension**	
26°C (79°F), mN/m (dyn/cm)	16–20
Isothermal Secant Bulk Modulus 38°C (100°F) and 34.5 MPa (5000 psi)	
MPa approximate	1034
psi approximate	150,000
Average Coefficient of Thermal Expansion	
per °C (25–99)	0.00095–0.00109
per °F (77–210)	0.00053–0.00061
Specific Heat, cal/g·C or Btu/lb·F	
–18°C (0°F)	0.20–0.21
38°C (100°F)	0.23–0.24
99°C (210°F)	0.25–0.26
204°C (400°F)	0.29–0.30
Specific Heat, kJ/kg·K	
–18°C (0°F)	0.84–0.88
38°C (100°F)	0.96–1.00
99°C (210°F)	1.05–1.09
204°C (400°F)	1.21–1.26
Thermal Conductivity**	
Btu·ft/h·ft²·F at 38°C (100°F)	0.048–0.054
Btu·ft/h·ft²·F at 260°C (500°F)	0.040–0.051
W/m·K at 38°C (100°F)	0.0831–0.0934
W/m·K at 260°C (500°F)	0.0692–0.0883

* This table gives typical properties (not specifications) based on historical production performance. Viscosity may vary within ±10%. DuPont does not make any express or implied warranty that these products will continue to have these typical properties.

** Increases slightly with increasing molecular weight.

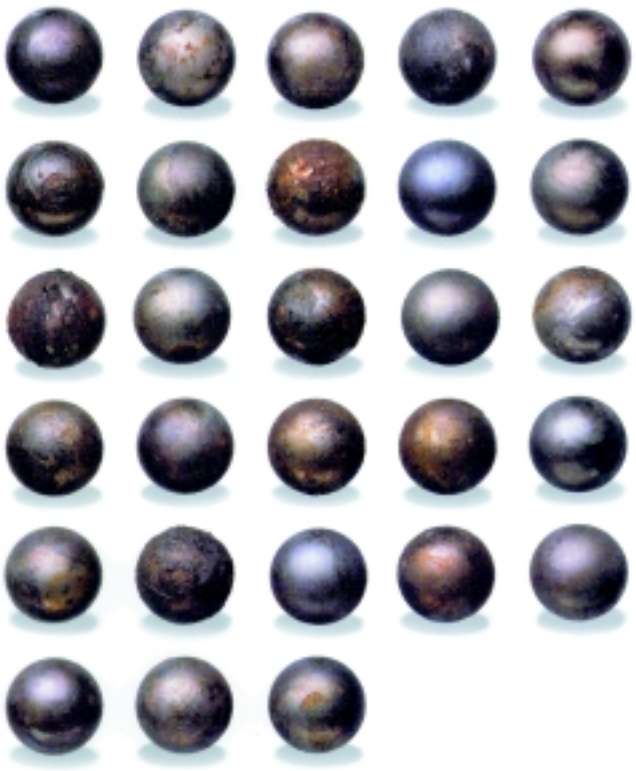
Additional Information and Literature Requests

The general physical characteristics of each Krytox® fluorinated oil product category are described in this brochure. More detailed data sheets showing specific properties for each Krytox® product are available. For more information or technical assistance, call (800) 424-7502.

Additional References for PFPE Lubricants

Synthetic Lubricants and High Performance Functional Fluids, Second Edition, Marcel Dekker, Inc.

Nine months worth of bearings.



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