Krytox™
Performance Lubricants

For Clean Room Applications

Product Information

Understanding Lubricants in Clean Rooms

Grease is a semisolid material that uses a thickener to hold the oil in place. The base oil is the largest component of any grease, but the grease's thickener and additives can also have a large impact on contamination of a clean room. Commonly used thickeners are metallic soaps of lithium and aluminum, solids like clay and silica, or solid polymers such as polytetrafluoroethylene (PTFE) and polyurea. Greases reduce the volume of lubricant needed from what would be typical in an oil system.

Lubricants for use in clean rooms require base oils that have been specially distilled to remove the more volatile, lighter molecules that might evaporate easily. In addition, the use of special thickeners that do not contain metals, reactive compounds, or large particles is also necessary to meet some clean room standards.

Hydrocarbon, polyalphaolefins (PAO), synthetic esters, silicones, polyphenyl ethers (PPE), and perfluoro-polyethers (PFPE) are a few common base oils used in the clean room environment. The least expensive choice is hydrocarbon- or PAO-based lubricants. These common base oils have good wear properties and can accept common additives; but, often, they don't handle high temperatures and minimal outgassing requirements. In addition, the additives necessary to keep them stable are reactive and can cause problems if they get on critical components.

Synthetic ester base oils have higher thermal stability, but are more reactive and can't be used with some elastomer seals and plastic materials. Silicone-based lubricants have a broader useful temperature range and are safe with plastics and seals, but are more compressible and don't do as well lubricating metal bearings. In addition, they have been known to creep into other areas, causing contamination issues.

At the high end of the performance scale are the PPE lubricants and PFPE lubricants, such as Krytox™ lubricants. These oils have higher molecular weight and low vapor pressure. The PPEs have good radiation resistance, but typically are not good lower temperature lubricants. PFPE lubricants offer wide temperature range capability, chemical inertness, and compatibility with almost all seals and plastic materials.

Factors That Influence Lubricant Selection

The potential for wear can be reduced in components by using components that roll, rather than slide, and by the proper selection of lubricants. Some lubricants have the potential to evaporate and create chemical vapors or decompose and form particles that can become airborne.

Cost is a factor in the selection of a lubricant. Consideration of its life cycle can show that the clean-up costs for a lubricant that has to be re-applied frequently can make it cost significantly more than a higher performing product that does not require repeated re-lubrication. The controls needed—to capture excess lubricant, chemical vapors given off, and particles generated from decomposition of the lube—and the risk of wear and failure of the equipment, because of lubrication issues—all add risk and cost.

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Microbial control presents an additional challenge in pharmaceutical, medical, and food processing clean room environments. Commonly, antiseptic cleaning, as well as thermal and radiation methods, are used to kill and remove microorganisms. If the actual lubricated component is directly subjected to any of these operations, it must be able to withstand the stress. Repeated steam sterilization in an autoclave at 121–132 °C (250–270 °F) can take many lubricants past the point that their additives and base oils can handle, leading to shortened life. Overzealous use of liquid sanitizers could flood a bearing with cleaner, causing corrosion or chemical decomposition of the base oil, thickener, or additives.

Lubricant selection ultimately becomes a matter of selection of the proper chemistry and physical properties that will not create contaminants from volatilization, chemical decomposition, or excess wear. While solid lubricants, such as molybdenum disulfide, PTFE coatings, or graphite, can reduce friction and reduce wear, they typically have short lives in most applications and are usually not used in rolling element bearings. While oils can be used as lubricants, they are typically used in systems that have oil reservoirs—where the oil is used both for lubrication and cooling.

Vapor pressure is another consideration to include when selecting a lubricant. The equipment must be properly lubricated with the correct viscosity base oil or it could fail rapidly. Many extreme vacuum greases use high viscosity base oils to lower vapor pressure. They won't outgas, but are so viscous that the balls of a bearing will skid and cause high wear—resulting in rapid failure and creating particles.

Recommended Grease Types

Krytox™ greases can meet many of the critical needs in clean room and robotic applications (see Table 1).

Key Considerations in Clean Room Applications

In addition to selecting high performance lubricants, the choice of bearings and seals used in the clean room equipment must also be carefully considered. Specially cleaned bearings with seals designed to reduce outgassing and particle generation are needed. Composition of the bearings could include stainless or ceramic balls, stainless races, and special cages.

External particles and other contaminants compete against the air filtering system. People entering a clean room are required to wear special clothing, all materials entering must meet special cleanliness standards, and the equipment is designed to generate minimal air contamination. If the moving equipment in the room is not lubricated or inadequately lubricated, particles can be generated inside the room from bearings, slides, seals, and the lubricants used.

Mechanical operations inside a clean room can range from vacuum system operations, manufacturing operations, such as molding, and final assembly. Virtually any place where metal can rub could potentially create micron-sized metallic wear particles, if the contact points are not lubricated. For instance, a mold has ejector pins, latch locks, and other components that slide. If the components are properly lubricated, the wear of these components can be minimized, reducing particle generation.

Table 1. Krytox™ Vacuum and Clean Room Greases[1]

Product	Base Oil Viscosity, cSt at 40 °C (104 °F)	Vapor Pressure, Torr	ASTM E595[2]	Applications
Krytox™ 240 AA	33	1×10^{-4} at 38 °C (100 °F)	—	Electronics
Krytox™ 240 AB	76	5×10^{-6} at 38 °C (100 °F)	—	Electronics
Krytox™ EG 2000	240	8×10^{-8} at 38 °C (100 °F)	Pass	Electronics
Krytox™ EG 3000	440	6×10^{-9} at 38 °C (100 °F)	Pass	Electronics
Krytox™ LVP	749	$<1 \times 10^{-13}$ at 20 °C (68 °F)	Pass	Sealing, Electronics
Krytox™ XHT-BD	599	$\leq 1 \times 10^{-9}$ at 20 °C (68 °F)	Pass	High temp flow solder ovens
Krytox™ XHT-BDX	738	$\leq 3 \times 10^{-14}$ at 20 °C (68 °F)	Pass	High temp flow solder ovens
Krytox™ XHT-BDZ	1023	$\leq 4 \times 10^{-15}$ at 20 °C (68 °F)	Pass	High temp flow solder ovens

[1]Note: These values are typical properties and not specifications.

[2]E595 criteria to pass is <1% for Total Mass Loss and <0.1% for Collected Volatile Condensable Material.

Table 2. Krytox™ Vacuum and Clean Room Oils[1]

Product	Base Oil Viscosity, cSt at 40 °C (104 °F)	Vapor Pressure, Torr	Applications
Krytox™ XHT-500	500	≤1 x 10^{-9} at 20 °C (68 °F)	Electronics
Krytox™ XHT-750	738	≤3 x 10^{-14} at 20 °C (68 °F)	Electronics
Krytox™ XHT-1000	1023	≤4 x 10^{-15} at 20 °C (68 °F)	Electronics

[1]Note: These values are typical properties and not specifications.

Krytox™ PFPE Lubricants

In addition to the wide temperature range capability, chemical inertness, and compatibility with most materials, Krytox™ PFPE lubricants offer selections of new soluble additives that provide improved lubrication properties. The higher density of 1.9 g/mL and higher molecular weight make Krytox™ PFPEs less likely to outgas.

Krytox™ PFPE lubricants have one additional characteristic that makes them an ideal choice for robotics. The static coefficient of friction is lower than the dynamic coefficient; so, they have no stick-slip, which eliminates jerkiness. This attribute supports the ability to precisely control and position components.

Krytox™ Lubricants—Ideal for the Clean Room Environment

- Exceptionally safe, reliable, and offer longer lubricant life
- Highly resistant to degradation in the presence of aggressive chemicals
- Perform well in both low and very high temperature conditions
- Protect equipment under high loads and slower speeds, while enabling components to last longer
- Will not burn or support combustion, even in 100% liquid or gaseous oxygen
- Do not damage plastics or elastomers, or cause corrosion to metals

Krytox™ lubricants are used in aerospace, automotive, industrial, and semiconductor applications, as well as in solving many other routine lubrication problems.

For product information, industry applications, technical assistance, or global distributor contacts, visit krytox.com or within the U.S. and Canada, call 1-844-773-CHEM/2436 or outside of the U.S., call 1-302-773-1000.

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