

your global specialist

PFPE products for extreme requirements.

Better performance and reliability attained
with special lubricant solutions





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PFPE – a special kind of chemistry

No matter in which branch of industry you work, you will no doubt be facing higher efficiency requirements, increasing machine power and a demand for less maintenance. Technical elements such as guideways and bearings made of various material combinations are expected to do their job even when confronted with aggressive media or extreme temperatures. With their excellent chemical stability, PFPE lubricants can be the solution for your requirements.

What makes PFPE lubricants so valuable for you?

PFPE (perfluorinated polyether) is a long-chain polymer made up of carbon, oxygen and fluorine. Due to the strong carbon-fluorine bond, the PFPE chain structure is extremely well protected and hence highly inert. This inertness provides excellent high-temperature performance and makes PFPE products extremely useful in the presence of highly reactive chemicals. PFPE are non-flammable and have low toxicity. This supports you in acting responsibly towards the environment, your employees and customers.

Why use a PFPE lubricant made by Klüber Lubrication?

Most of our PFPE base oils are exclusively produced for Klüber Lubrication and as raw materials are unrivalled in the field of PFPE lubricants. By using such oils and our sophisticated production technology to make PFPE greases of high purity and extraordinary homogeneity, we can offer you PFPE products with an outstanding performance. Our strength is close cooperation with customers and partners, for whom we also develop tailor-made products.

Well-known PFPE product families:



Unique testing section

When developing and testing our speciality lubricants, we take the specific requirements of our customers as our yardstick. Our unique test house offers more than 100 testing installations, some of which we have developed ourselves for particular testing purposes.

Global presence

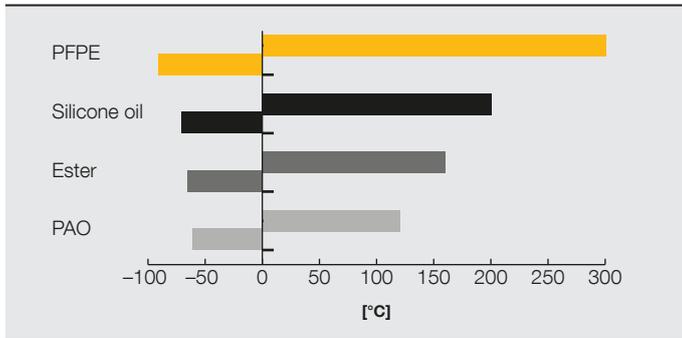
We are where you are. Our experts are there to support you, wherever you need them. To find a customised, individual solution together with you, our experienced sales specialists and application engineers will be pleased to assist you.

Extreme temperatures

High temperatures

PFPE products serve a wider temperature range than other lubricant designs. Depending on the individual product involved, PFPE-based greases can be used at temperatures from $-70\text{ }^{\circ}\text{C}$ to more than $300\text{ }^{\circ}\text{C}$.

Service temperature ranges of various lubricant base oils



One of the particular strong points offered by PFPE lubricants is their use for lubricating friction points operating under high thermal loads. In contrast to conventional greases, they are not subject to oxidation and show less evaporation losses. This enables longer relubrication intervals and, in most cases, even for-life lubrication.

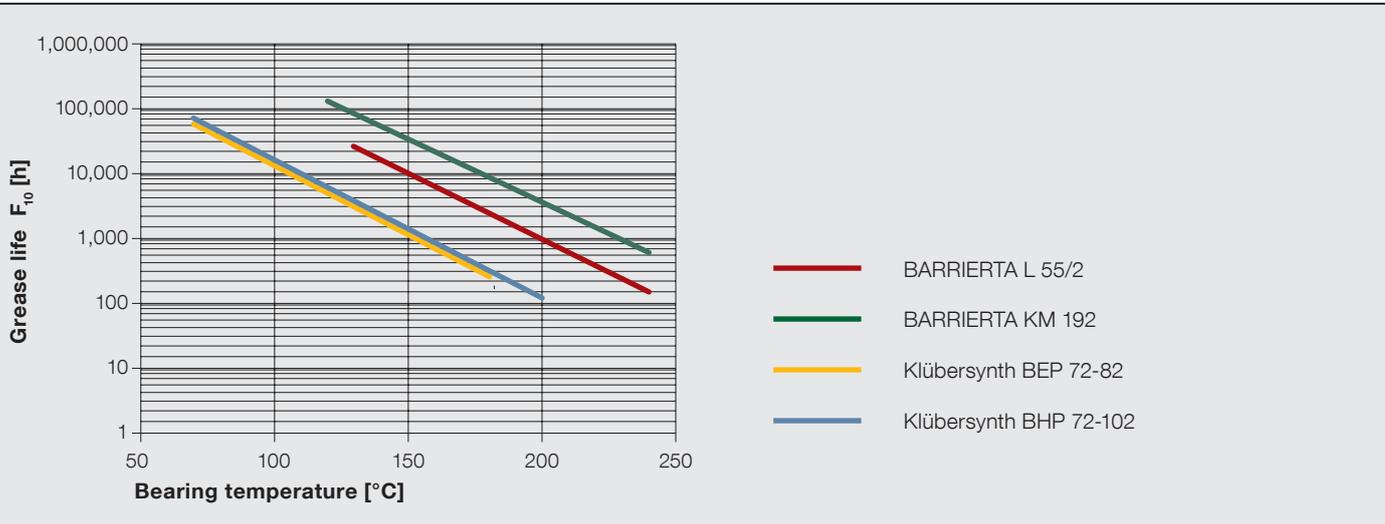
The **BARRIERTA L55** series of greases has been tried and tested in the field for several decades. When used in rolling bearings exposed to thermal stress up to $260\text{ }^{\circ}\text{C}$, it helps attain very long relubrication intervals and a long bearing life. BARRIERTA L55 is a high-temperature grease for use in many different applications, ranging from rolling bearings in thermally loaded calenders in the textile or chemical industries, to ovens in bakeries.

For sliding rails in ovens operating at up to $300\text{ }^{\circ}\text{C}$, **Klüberalfa HPX 93-1202** is a highly reliable option. It is based on a special inorganic thickener and a highly viscous oil with excellent thermal stability and a narrow molecular weight distribution.



For high-temperature applications in the food industry, the H1-registered PFPE lubricants BARRIERTA L55 and Klüberalfa HPX 93-1202 are the right choice.

Grease life as a function of temperature



Typical grease lives of PFPE greases compared with other types of grease based on typical F10 runtimes on FAG-FE9 and SKF-ROF testing machines

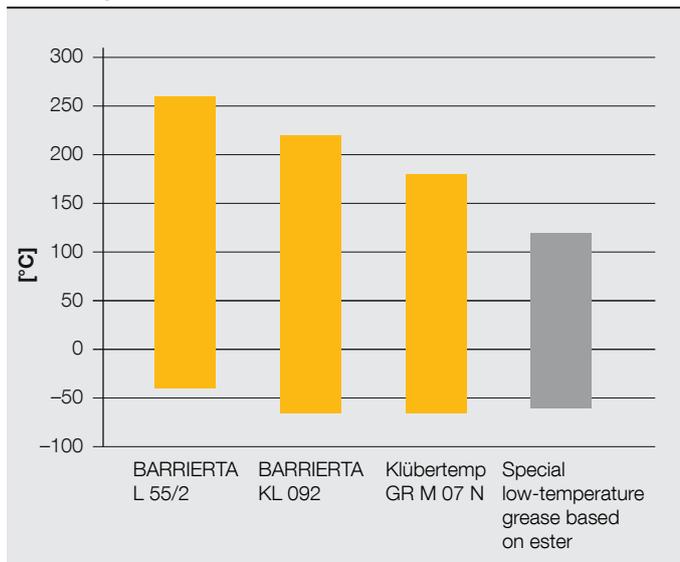


Low temperatures

Bearings and guideways that are exposed to high temperatures are likewise often required to work at normal or even very low temperatures. Also when cold, the component has to start smoothly. This applies also to applications with operating temperatures far higher than the temperature range normally served by typical low-temperature lubricants.

PFPE oils with a linear structure, such as those used for the **Klübertemp GR M** greases, hardly change their viscosity over a wide temperature range. Furthermore, the Klübertemp GR M greases offer low breakaway torques, exceptionally low friction coefficients as well as good compatibility with plastics and elastomers. This is why these greases are preferably used in the automotive industry, for example in applications involving haptic damping and the elimination of unwanted noise.

Service temperature ranges of selected PFPE products made by Klüber Lubrication



Lubricants in cars have to work at $-40\text{ }^{\circ}\text{C}$ just as well as at $200\text{ }^{\circ}\text{C}$ peaks.

BARRIERTA KL 092 combines low running torques at low temperature with sound long-term stability under strong influence of media and high temperatures. These extreme temperature ranges are attained by our base oils that are made to very tight specifications. Our sophisticated production processes comprise several manufacturing steps and are subject to continuous quality control measures, enabling the manufacture of an extremely pure and homogeneous grease satisfying even the most stringent of quality requirements.

Influence of media, sensitive materials

Influence of media



PFPE greases from Klüber Lubrication make an important contribution towards ensuring the functionalities of components even under the influence of chemicals, UV radiation or X-rays.

If direct contact between the lubricant and aggressive media cannot be avoided, lubricants have to offer particularly high resistance. This kind of chemical stability is found in the PFPE-based lubricants from Klüber Lubrication because of their specific structure and purity.

Klüberalfa PI 83-271 is also a good choice for lifting and metering equipment operating under the influence of media in laboratory automation, pneumatic cylinders and valves as well as in dynamically loaded seals and plastic guideways.



The strengths of PFPE oxygen sliding agents made by Klüber Lubrication become particularly apparent when used in valves, fittings and installations carrying oxygen under extreme pressure. **Klüberalfa YV 93-1202**, for instance, shows an extraordinarily high resistance to oxygen surges and very good resistance to various chemicals. To ensure continuous adherence to this high quality standard, **Klüberalfa YV 93-1202** is produced in small batches applying very strict manufacturing criteria, and each batch is tested for resistance to gaseous and liquid oxygen.

Klüber Tyreno Fluid 6-14 V is a filling fluid for vacuum pumps offering high operational reliability in installations and components where it comes into contact with gaseous oxygen.

Klüber Tyreno Fluid 3-6 V is used, for example, as a barrier fluid for mechanical seals in the chemical industry, as its chemical stability is very high and the product is resistant to aggressive media, hydrocarbons, solvents, acidic and alkaline solutions.



Sensitive materials

EPDM or NBR seal? Polar or homopolar polyethylene? These questions normally need to be answered when selecting a lubricant. When using PFPE-based lubricants, such considerations no longer matter. As you don't have to resort to silicone oil, you are free to use the material combinations you prefer. Most PFPE-based lubricants are neutral towards customary plastics and elastomers.



BARRIERTA L 25 DL can help you keep friction low even at temperatures of $-25\text{ }^{\circ}\text{C}$, especially when lubricating seals in train doors. A long seal life is also attained where there is exposure to water or sunlight.

Our PFPE-based oils **Klüberalfa MR 3**, **Klüberalfa YM 3** and **Klüberalfa DH 3** are capable of meeting customers' increasing demand for a high comfort level inside their cars. They are odourless, compatible with most thermoplastics and duroplastics, and help to reduce unwanted noise in various friction points, for example on the dashboard, in armrests and seat adjustment mechanisms.

Klüberalfa YM 3-N and **Klüberalfa DH 3-N** have a high wetting capacity and can therefore be applied in a very thin layer for better cost-efficiency. These oils reduce stick-slip effects to prevent the generation of noise in slide rails in headrests as well as in control and comfort elements such as cup holders and displays.



Hint:

Prior to series application, however, you should always verify the compatibility of the lubricant with the materials in contact, since there are so many of them and operating conditions can vary greatly.

Resistance to vacuum



A lubricant has to function reliably even in high or ultra-high vacuum conditions. Excessive evaporation losses lead to a higher risk of lubricant starvation and are detrimental to quality, due to abrasion and condensates. Vacuum-resistant PFPE lubricants made by Klüber Lubrication support sensitive manufacturing processes.

This is why our quality requirements are particularly stringent when selecting raw materials for our vacuum greases and oils as well as during manufacture of these lubricants. The narrow molecular weight distribution of the PFPE oils used keeps evaporation losses and vapour pressure very low.

The following pump designs are common in vacuum technology:

Pump designs	
Pump design	Attainable pump pressure
Roots pumps	300 to 1,0 Torr
Rotary vane pumps	1,0 to 1×10^{-3} Torr
Turbopumps	1×10^{-3} to 1×10^{-11} Torr
Diffusion pumps	1×10^{-7} to 1×10^{-11} Torr

The lubricant must be selected to match the pump pressure that can be achieved with the design being used. For use in a vacuum, a lubricant should always be chosen whose vapour pressure at service temperature is at least 2 to 3 powers of ten lower than the attainable pump pressure.

For the vapour pressure ratings of the base oils of some of our products, please see the following table.

Vacuum resistance of selected PFPE lubricants

Product	Maximum vapour pressure acc. to Knudsen at 20 °C
BARRIERTA L 55/2	5×10^{-13} Torr
Klüberalfa HPX 93-1202	4×10^{-15} Torr
Klüberalfa HX 83-302	$3,5 \times 10^{-9}$ Torr
Klüber Tyreno Fluid 12/25 V	10^{-10} Torr
Klüber Tyreno Fluid 80 V	10^{-13} Torr



In semiconductor manufacturing, the high vacuum and exposure to media pose a particular challenge to the lubricant.

High speeds, centrifugal forces

For fast-rotating bearings operating at high temperature or under the influence of media, PFPE lubricants may not sound like the obvious option since these products are not known for their high-speed characteristics. We have, however, developed a special product concept and succeeded in pushing the performance limits of our products considerably. It is our ample experience and our knowledge of which base materials and processes are instrumental in developing, testing and efficiently manufacturing a speciality lubricant that have made this specific solution possible.

When, for example, **Klüberalfa BF 83-102** was subjected to long-term tests with 160 °C permanent temperature, a speed factor for deep groove ball bearings of 1,000,000 was achieved, which is rather unusual for a PFPE lubricant.

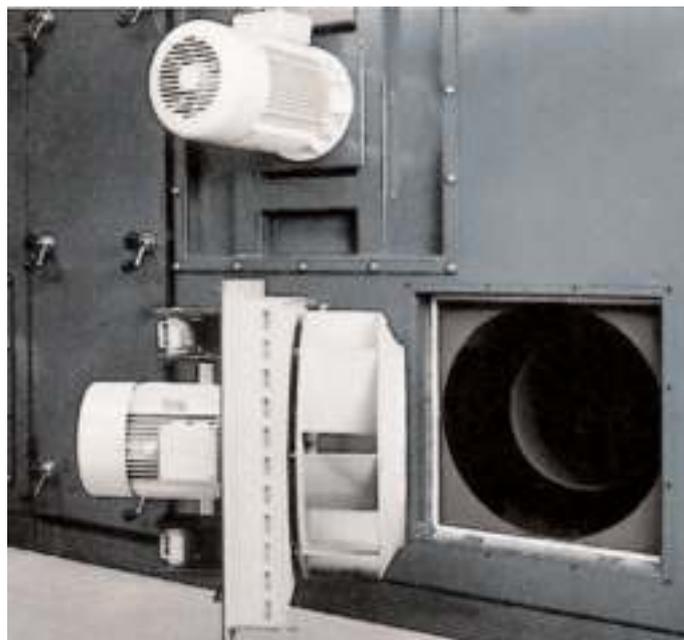
Speed factor



The speed factor $n \cdot d_m$ is the product of the speed of the bearing at standard operating conditions n (in min^{-1}) multiplied by the mean bearing diameter d_m (in mm).

The upper speed limit of a grease depends to a high degree on the base oil type, the base oil viscosity, the thickener and the type of rolling bearing to be lubricated. Important factors for successful lubrication at high speed include rapid oil backflow to the friction point, constant, defined oil release from the thickener as well as the grease's adhesion to the component material.

Please see the table on the right for speed factors to be expected for some of our products.



Klüberalfa BF 83-102 has been tried and tested in fan bearings, small turbines, generator bearings and many other applications. Even at low temperatures, this lubricant is light enough so as not to overload low-torque drives.

Speed factors of selected PFPE greases

Product	Speed factor
BARRIERTA L 55/2	approx. 300,000 $\text{mm} \times \text{min}^{-1}$
BARRIERTA KM 192	approx. 600,000 $\text{mm} \times \text{min}^{-1}$
Klüberalfa BF 83-102	approx. 1,000,000 $\text{mm} \times \text{min}^{-1}$

Overview of selected PFPE greases

	BARRIERTA L 55/2	BARRIERTA KM 192	BARRIERTA KL 092	BARRIERTA I MI 202	BARRIERTA I EL-102	BARRIERTA L 25 DL	Klüberalfa HX 83-302
Application							
Rolling bearings	X	X	X	X			X
Plug-in contacts				X	X		
Oxygen sliding agents							
Vacuum	X				X		X
Plastic friction points			X			X	
Small gears							
Slideways						X	X
Conveyors	X						
Precision engineering				X	X	X	
Requirements							
Upper service temperature	260 °C	260 °C	220 °C	240 °C	180 °C	150 °C	240 °C
Lower service temperature	-40 °C	-50 °C	-65 °C	-45 °C	-50 °C	-40 °C	-60 °C
Ultra-high vacuum at ambient temp. (1E ⁻⁹ Torr to 1E ⁻¹² Torr)	X						
High vacuum at ambient temp. (1E ⁻³ bis 1E ⁻⁹ Torr)	X				X		X
Suitable for high speeds		X		X			
H1 registration	X				X		

This is a small selection of our comprehensive portfolio of more than 100 PFPE products. Our experts will be pleased to provide more detailed information.



Kiüberalfa PI 83-271	Kiüberalfa BF 83-102	Kiüberalfa BHR 53-402	Kiüberalfa HPX 93-1202	Kiüberalfa YV 93-1202	Kiüberalfa YV 93-302	Kiübertemp YV 93-92	Kiübertemp GR AR 555	Kiübertemp RHB 83-202	Kiübertemp GR M 07 N	Kiübertemp GR M 30 N
	X						X	X		
				X	X	X				
			X						X	X
X			X					X	X	X
		X					X			
X										
200 °C	200 °C	260 °C	300 °C	200 °C	200 °C	160 °C	250 °C	240 °C	180 °C	200 °C
-60 °C	-50 °C	-40 °C	-20 °C	-60 °C	-60 °C	-60 °C	-30 °C	-45 °C	-65 °C	-60 °C
			X							
	X									
	X		X	X	X	X		X		

Overview of selected PFPE oils

	Kiüber Tyreno Fluid 3/6 V	Kiüber Tyreno Fluid 6/14 V	Kiüber Tyreno Fluid 12/25 V	Kiüber Tyreno Fluid 80 V	Kiüberalfa MR 3	Kiüberalfa MR 3-500	Kiüberalfa MR 3-800
Application							
Rolling bearings							
Plug-in contacts							
Oxygen sliding agents	X	X	X				
Vacuum	X	X	X	X			
Plastic friction points					X	X	X
Slideways					X	X	X
Plain (sintered) bearings							
Chains							
Requirements							
Upper service temperature	dep. on application	dep. on application	dep. on application	250 °C	180 °C	200 °C	250 °C
Lower service temperature	dep. on application	dep. on application	dep. on application	-20 °C	dep. on application	dep. on application	dep. on application
Ultra-high vacuum at ambient temp. (1E ⁻⁹ Torr to 1E ⁻¹² Torr)				X			
High vacuum at ambient temp. (1E ⁻³ bis 1E ⁻⁹ Torr)	X	X	X	X			
H1 registration							

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Kiüberalfa DH 3-320N	Kiüberalfa YM 3-30	Kiüberalfa YM 3-30 N	Kiüberalfa YM 3-65 N	Kiüberalfa KRA 3-730	Kiüberalfa HL 3-150	Kiüberalfa HL 3-300	BARRIERA IS Fluid	BARRIERA I EL Fluid
							X	X
	X			X				
					X	X	X	X
X	X	X	X				X	X
X	X	X	X			X	X	X
						X	X	X
230 °C	100 °C	100 °C	120 °C	140 °C	250 °C	250 °C	260 °C	180 °C
-25 °C	-60 °C	-50 °C	-40 °C	-40 °C	-60 °C	-60 °C	-25 °C	-40 °C
							X	
					X	X	X	X
	X						X	

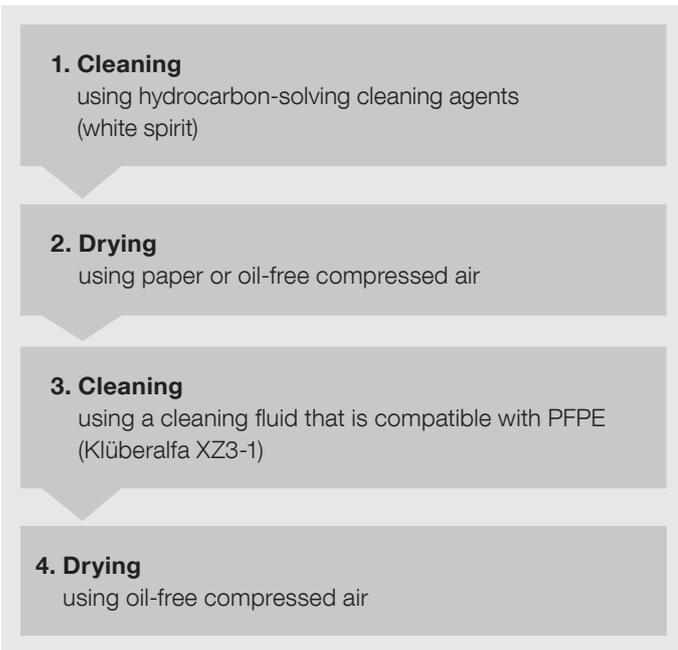
Application notes

Initial greasing and cleaning

PFPE lubricants offer best adhesion on bright surfaces that are absolutely free of grease. Thorough cleaning prior to greasing is a prerequisite for optimum results to be attained with your lubricants.

The cleaning fluid Klüberalfa XZ 3-1 removes any hydrocarbon solvent residues and evaporates quickly and completely.

Cleaning in 4 steps



Klüberalfa XZ 3-1 is a dispersant, solvent and cleaning agent for use in combination with PFPE lubricants. Its boiling point is at about 55 °C. The chemical composition of Klüberalfa XZ 3-1 is very similar to that of perfluorinated polyether (PFPE). For this reason, lubricants based on PFPE are dissolved or dispersed in Klüberalfa XZ 3-1. Klüberalfa XZ 3-1 is not a chlorinated fluorocarbon (CFC) and is therefore not subject to the CFC/ halon prohibition ordinance.

Klüberalfa XZ 3-1 is registered as NSF H1 and complies with FDA 21 CFR § 178.3570. It was developed for incidental contact with products and packaging materials in the food-processing, cosmetics, pharmaceutical or animal feed industries.

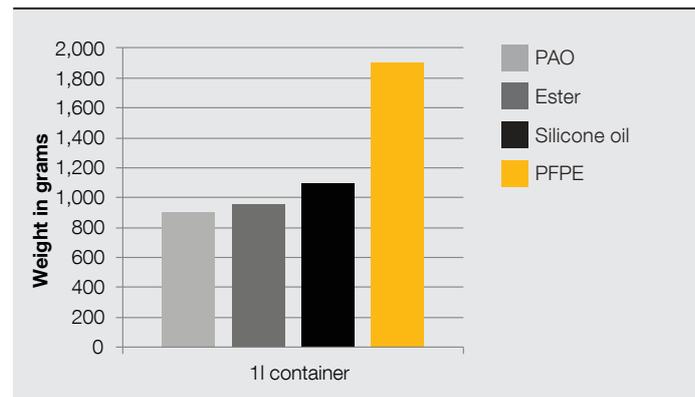
Miscibility with other lubricants

PFPE-based greases are miscible with one another. Other types of lubricant cannot be mixed with PFPE greases, irrespective of the mixing ratio. For this reason, the friction points should be thoroughly cleaned prior to a lubricant changeover, as described above, in order to attain maximum lubricity.

Higher density

When determining the grease quantity and selecting the viscosity for a specific application, the fact that the density of PFPE lubricants is almost twice as high should be taken into account.

Density of various lubricant types





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Klüber Lubrication – your global specialist

Innovative tribological solutions are our passion. Through personal contact and consultation, we help our customers to be successful worldwide, in all industries and markets. With our ambitious technical concepts and experienced, competent staff we have been fulfilling increasingly demanding requirements by manufacturing efficient high-performance lubricants for more than 85 years.